City of Milwaukee

Department of Public Works

Infrastructure Services Division Facilities Development & Management Section

MPD – POLICE EVIDENCE WAREHOUSE
FIRE SUPPRESSION SYSTEM INSTALLATION

2620 West Wisconsin Avenue
Milwaukee, Wisconsin

December, 2013

Project Number PL120040120
Official Notice No. 11

CITY OF MILWAUKEE, WISCONSIN

DEPARTMENT OF PUBLIC WORKS

INFRASTRUCTURE SERVICES DIVISION

FACILITIES DEVELOPMENT &

MANAGEMENT SECTION

PROJECT MANUAL

GOVERNING THE

MPD — POLICE EVIDENCE WAREHOUSE

FIRE SUPPRESSION SYSTEM INSTALLATION

2620 WEST WISCONSIN AVENUE

MILWAUKEE, WISCONSIN

Project No. **PL120040120**

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TABLE OF CONTENTS

TABLE OF CONTENTS	PAGE NO.
BIDDING REQUIREMENTS	
00030 City of Milwaukee General Official Notice	00030/1
00031 City of Milwaukee Specific Official Notice	00031/1-2
00100 Instructions to Bidders	00100/1-4
GENERAL CONDITIONS	
00700 General Conditions	00700/1-4
00821 Inspection Charges	00821/1
00822 Prevailing Wage Scale	00822/ 1-30
00850 Drawing Schedule	00850/1
GENERAL REQUIREMENTS	
01010 Summary of Work	01010/1-5
01210 Project Meetings	01210/1-2
01300 Submittals and Permits	01300/1-3
01500 Job Site Utilities, Facilities, and Security	01500/1-5
01505 Construction Waste Management	01505/1-4
01600 Materials and Equipment	01600/1-3
01700 Cleaning and Project Close-Out	01700/1-3
01820 Training	01820/1-4
GENERAL CONSTRUCTION	
02225 Trench Backfill	02225/1-5
02510 Water Utility Distribution Piping	02510/1-12
02920 Soil Preparation	02920/1-2
02950 Sodding	02950/1-3
03300 Cast-In-Place Concrete	03300/1-8
04200 Unit Masonry	04200/1-10
07844 Fire-Resistive Joint Systems	07844/1-5
07920 Joint Sealants	07920/1-6
08111 Hollow Metal Doors and Frames	08111/1-8
08700 Door Hardware	08700/1-8
09900 Painting and Coatings (Professional Line Products)	09900/1-12
HVAC	
15010 Basic Mechanical Requirements	15010/1-17
15140 Supports, Anchors and Sleeves	15140/1-6
15250 Thermal Insulation	15250/1-7
15860 Centrifugal Fans	15860/1-3
15890 Metal and Flexible Duct	15890/1-7
15910 Ductwork Accessories	15910/1-7
15936 Air Inlets and Outlets	15936/1-3

15990 Testing, Adjusting and Balancing 15990/1-5

FIRE SUPRESSION SYSTEMS

15000C Common Work Results for Fire Suppression 15000C/1-11
15060C Fire Suppression Pipe and Fittings 15060C/1-11
15140C Fire Suppression Hangers and Supports 15140C/1-7
15300C Water-Based Fire Suppression Systems 15300C/1-18
15320C Fire Pumps 15320C/1-6

ELECTRICAL

16010 Basic Electrical Requirements 16010/1-10
16050 Basic Electrical Materials and Methods 16050/1-11
16060 Grounding and Bonding 16060/1-6
16120 Conductors and Cables 16120/1-5
16130 Raceways and Boxes 16130/1-10
16140 Wiring Devices 16140/1-6
16410 Safety Disconnect Switches/Enclosed Circuit Breakers 16410/1-5
16491 Fuses 16491/1-3
16515 Interior Lighting Fixtures 16515/1-8
16721 Fire Alarm Systems 16721/1-24
16740 Telephone and Data Cabling System 16740/1-25

CITY OF MILWAUKEE
GENERAL OFFICIAL NOTICE
TO CONTRACTORS

Separate sealed bids for each project will be received until 10:30 A.M. of the bid opening date at which time bids will be publicly opened and read for furnishing all material and doing all work for each project in accordance with the requirements of the respective Official Notice on the bid form furnished in accordance with plans, specifications, contract documents, and proposed form of contract on file in the office of the Department of Public Works, Municipal Building, 841 N. Broadway, Room 506, Milwaukee, Wisconsin, 53202.

PROSPECTIVE BIDDERS ARE TO CAREFULLY EXAMINE AND REVIEW ALL CONTRACT DOCUMENTS AND MATERIALS IN SAID OFFICE BEFORE SUBMITTING BID.

AFFIDAVITS OF NO INTEREST MUST ACCOMPANY THE BIDS, AND THE FAILURE OF PROSPECTIVE BIDDERS TO COMPLY WITH THESE REQUIREMENTS MAY DISQUALIFY THE BID.

THE CONTRACTOR/LESSEE AGREES TO COMPLY WITH ALL APPLICABLE REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT OF 1990, 42 U.S.C. § 12101, ET. SEQ. THE TDD NUMBER FOR PUBLIC WORKS IS (414) 286-2025.

As part of the bid each bidder shall submit a list of anticipated subcontractors and the class of work to be performed by each, which list should not be added to nor altered without the written consent of the Commissioner of Public Works.

All contractor(s) and subcontractor(s) are required to furnish or have on file a certificate of insurance in accordance with the insurance provisions of the General Specifications.

All contractor(s) and subcontractor(s) are subject to the prevailing wage rates and hours of labor as prescribed by the Common Council of the City of Milwaukee consistent with provisions of Section 66.0903 of the Wisconsin Statutes.

Copies of the actual work classifications and wage and fringe benefit rates enforced on this project are available in Room 506 of the Municipal Building.

Corporate surety will be required on performance and payment bonds for all projects listed in the following Official Notices. All applicable charter and Statutory provisions and ordinances, all the provisions of this official notice, invitation to bid, general and detailed specifications, special provisions, proposal, schedule of fixed prices, addendum and plans for this project and all other contract documents set forth in the invitation to bid will be incorporated and made part of the contract as if therein set forth in full.

Tie bids, when the lowest ones, will be decided by the Commissioner of Public Works.

The Commissioner of Public Works reserves the right to reject any or all bids.

Signed: GHASSAN KORBAN,
Commissioner of Public Works

Countersigned: MARTIN MATSON,
City Comptroller

CITY OF MILWAUKEE
SPECIFIC OFFICIAL NOTICE NO. 11

Important Notice:

The Invitation to Bid, all bid documents and the Plans & Specifications for the project listed will be available electronically to prospective bidders via **http://www.mpw.net/bids/docs/11-2014.** Any required addenda or responses related to the listed projects will be posted on said website. Bidders are encouraged to utilize this electronic method of obtaining bid documents as the Department of Public Works intends to solely use this method for future projects. At this time however, a limited number of hard copies of the above documents will also be available at address listed below. **IF YOU ONLY PRINT THE DOCUMENTS FROM THE WEBSITE AND WOULD LIKE YOUR COMPANY'S NAME PLACED ON THE PLAN HOLDERS' LIST, PLEASE CALL 414-286-3314.**

Sealed bids will be opened on **Friday, January 24, 2014 at 10:30 A.M**. for the **MPD-Police Evidence Warehouse Fire Suppression System Installation located at 2620 West Wisconsin Avenue, Milwaukee, WI.**

Bid Security Required: Bond (either Electronic thru Bid Express or Paper), Certified Check, Cashier's Check or Cash to accompany bid: 10% of the Contractor's Base Bid. For those bids being submitted through BID EXPRESS and using a Paper Bond, the contractor may fax a signed/executed copy of the bid bond to the Department of Public Works Contract Office at 414-286-8110. **HOWEVER, THE FAXED COPY OF THE BOND MUST BE RECEIVED BY NO LATER THAN 10:30 A.M. ON THE SAME DATE THAT THE BIDS ARE DUE FOR THAT SPECIFIC OFFICIAL NOTICE, or the bid will be considered non-responsive.** *The original bid bond document will then need to be submitted by the contractor to the Department of Public Works Contract Office, Rm. 506, Municipal Building, immediately upon being notified that they are the apparent low bidder*

Time for Completion: 100 Working Days.

Liquidated Damages, per diem: $317.00

Project Start Date: **No earlier than September 13, 2014.**

The SBE requirement for this project is 5% of the contract base bid.

The residency requirement for this project is 0% of all hours worked on the project.

The apprenticeship requirements for this project are: **1**

Sprinkler Fitter

For a complete listing of *City of Milwaukee certified SBE firms,* see the Office of Small Business Development (OSBD) website at milwaukee.gov/osbd. If there are any questions regarding SBE certified firms, please contact the OSBD office at 414-286-5553.

The contractor shall specifically note the SBE, residency, and apprenticeship forms for this project. If the forms are not filled out properly, it will be cause for rejection of the bid.

IMPORTANT NOTICE: The Invitation to Bid, all bid documents and the Plans and Specifications for the listed project(s) are all available electronically on the DPW website AS WELL AS **on the Bid Express Website**. At this

time, Bids can be submitted using either Bid Express OR by purchasing and submitting paper bids in the usual manner. However, Bidders are strongly encouraged to utilize the electronic and/or Bid Express methods of obtaining bid documents and Bid Express for submitting bids, as in the near future the Department of Public Works intends to have bid documents available only electronically and through Bid Express, *and to accept bid submittals only via Bid Express.*
Electronic documents can be obtained via http://www.mpw.net/bids/docs/11-2014. The Bid Express website is located at bidexpress.com. Any required addenda or response related to listed projects will be posted on both the DPW and Bid Express websites. At this time there are still a limited number of hard copies of the bid documents available at the address listed below. IF YOU ONLY PRINT THE DOCUMENTS THE DPW WEBSITE PLEASE CALL 414-286-3314 TO HAVE YOUR COMPANY'S NAME AND CONTACT INFORMATION PLACED ON THE PAN HOLDER'S LIST.

Plans and project manual will be furnished to the prospective bidders upon payment of a $10.00 non-refundable fee in room 506, Frank P. Zeidler Municipal Building, 841 North Broadway, Milwaukee, Wisconsin 53202. For general questions call 414-286-3314.

A $10.00 per set additional non-refundable fee is required to obtain bid documents by mail. Plans are sent via U.S. mail unless other arrangements are made by the contractor.

Contractor must comply with all provisions of the CITY OF MILWAUKEE GENERAL OFFICIAL NOTICE TO CONTRACTORS published herein and at http://mpw.milwaukee.gov/services/bids_home

Mandatory Pre-Bid Meeting: A Mandatory Pre-Bid Meeting is scheduled for **Friday, January 17, 2014 at 10:30 a.m. at 2620 West Wisconsin Avenue (lunch room), Milwaukee, Wisconsin.** Bidder participation is required to become familiar with all aspects of the project and bidding requirements. Contractors not attending the Pre-Bid meeting and field visit shall be ineligible to bid.

Signed:

_____
GHASSAN KORBAN
Commissioner of Public Works

PUBLISH SIX (6) TIMES INSERTION WITHOUT FAIL, Friday, January 10, 2014

SECTION 00100: INSTRUCTIONS TO BIDDERS

See also Instructions to Bidders in the "General Specifications" of the Department of Public Works, City of Milwaukee, Wisconsin, dated October 26, 2012, ,and all subsequent addenda.

BID FORM:

Submit a lump sum price for the work as indicated on the drawings and specified herein, complete in every respect.

Bids will not be accepted in any form except on the bid form included with this project manual.

The contractor must recognize and abide by the right of the Owner (City of Milwaukee) to accept or reject any or all bids in the best interests of the City.

ALTERNATES:

Each bidder shall examine the plans and project manual thoroughly to determine what extent the Alternates will affect the bid.

Alternate Deduct No. 1:

State the amount to be **deducted from** the Base Bid to perform all work and furnish all materials for the following items as denoted below:

Basement Level

a. Remove zone control valve and all wet pipe sprinkler system from Basement level. Provide capped outlet for future sprinkler connection at the location of the sprinkler zone control valve as indicated in Storage B-2. Remove fire tamper and flow switch monitoring from zone control valve. Note: sprinkler head and associated fire alarm work shall remain to serve freight elevator pit.

Alternate Deduct No. 2:

State the amount to be **deducted from** the Base Bid to perform all work and furnish all materials for the following items as denoted below:

First Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in Garage #114. Remove monitoring of preaction control system and all associated preaction smoke and heat detectors.

b. Remove zone control valve and all wet pipe sprinkler system from First Floor level. Provide capped outlet off standpipe for future sprinkler connection at the location of the sprinkler zone control valve as indicated in Viewing #105. Remove fire tamper and flow

switch monitoring from zone control valve.

Alternate Deduct No. 3:

State the amount to be **deducted from** the Base Bid to perform all work and furnish all materials for the following items as denoted below:

Mezzanine Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in Storage #M102. Remove monitoring of preaction control system and all associated preaction smoke detectors.

Alternate Deduct No. 4:

State the amount to be **deducted from** the Base Bid to perform all work and furnish all materials for the following items as denoted below:

Second Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in Storage #202. Remove monitoring of preaction control system and all associated preaction smoke detectors.

Alternate Deduct No. 5:

State the amount to be **deducted from** the Base Bid to perform all work and furnish all materials for the following items as denoted below:

Third Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in North Vault #304. Remove monitoring of preaction control system and all associated preaction smoke detectors.

Alternate Deduct No. 6:

State the amount to be **deducted from** the Base Bid to perform all work and furnish all materials for the following items as denoted below:

Fourth Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in Storage #402. Remove monitoring of preaction control system and all associated preaction smoke detectors.

Alternate Deduct No. 7:

State the amount to be **deducted from** the Base Bid to perform all work and furnish all materials for the following items as denoted below:

Fifth Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in Storage #502. Remove monitoring of preaction control system and all associated preaction smoke detectors.

b. Wet system piping, sprinklers, and detection in freight elevator shaft and Penthouse (Machine room) will be included under the base bid.

Alternate Deduct No. 8:

State the amount to be **deducted from** the Base Bid to perform all work and furnish all materials for the following items as denoted below:

Preaction Valve Trim

a. Remove installation of pre-packaged preaction valve cabinet as indicated in Detail #1 on Sheet FP-5. Install preaction valve, valve trim, air compressor, air maintenance device, and releasing panel exposed. See Detail #2 on Sheet FP-5 for alternate preaction valve trim schematic.

CONTRACT AWARD:

The Commissioner of Public Works will award the contract on the basis of the Base Bid only or the Base Bid and the Deduct Alternate(s) as selected, and as funds permit.

CONTRACT BREAKDOWN:

Shortly after the award of the contract, each contractor shall submit a list showing the cost breakdown of the items in his contract. This list will be used as a basis for estimates of work completed for partial payment.

SITE VISIT:

All contractors shall visit the site, consult the drawings and project manual, be familiar with the work of other contractors and determine for himself all conditions affecting the work.

Failure by a contractor to be familiar with the project shall not release him from any obligation under this contract to complete the work in strict conformity with the plans and project manual and all City, State and Federal Codes or regulations pertaining to the work.

TIME FOR COMPLETION:

The time allowed for completion is stated in the Specific Official Notice and shall start with the date on the Notice to Proceed which will be sent to the contractor directly following the signing of the contract. The time allowed includes time required for fabricating and procuring material and doing the work at the building site.

BASE BID EXCLUSIONS:

None

ADDITIONAL PLANS/PROJECT MANUALS

The successful contractor will be responsible for furnishing all additional copies of plans, project manuals, addenda, etc., as may be needed by the contractor and subcontractors. The City will cooperate by making originals available to the contractor's printer of choice.

SECTION 00700: GENERAL CONDITIONS

1. SCOPE:

A. Index:

1. Scope
2. DPW General Specifications
3. Definitions
4. Control of Work and Materials
5. Samples and Tests
6. Project Coordination
7. Supervision of Work
8. Technical Specifications and Drawings
9. Safety Regulations
10. Code Rules

2. Department of Public Works General Specifications:

Provisions of the Department of Public Works General Specifications dated January 31, 1992, and subsequent addenda except as may be modified or expanded upon in this project manual, shall apply to all contractors and subcontractors working on the project. Copies of the General Specifications may be obtained from the Department of Public Works General Office, Room 501 Zeidler Municipal Building, 841 North Broadway, Milwaukee, Wisconsin, or from the Facilities Development and Management Section, Room 602, Zeidler Municipal Building.

3. Definitions:

A. Owner: City of Milwaukee.

B. Facilities Manager: The Facilities Manager of the Facilities Development and Management Section.

C. Project Inspector: The authorized representative of the Commissioner assigned to make detailed inspection of any or all portions of the work and materials thereof. These inspections are not a substitute to those required by the Department of Neighborhood Services for permit and code compliance.

D. Addenda: Written or graphic instruments issued prior to the execution of the contract which modify or interpret the bidding documents, including drawings and project manual by additions, deletions, clarifications or corrections. Addenda will become part of the contract documents when the contract is executed.

E. Contract Drawings: Drawings of the work to be done as listed hereafter in Section 00850 Drawing Schedule and/or Section 00870 Plans and Details.

F. Utility: WE Energies.

G. End User: City of Milwaukee.

4. Control of Work and Materials:

A. Detail and Shop Drawings: Shop drawings and other additional drawings which may be required for each contract of the work shall be prepared by each respective contractor unless otherwise directed by the Facilities Manager. Prints shall be the same size as contract documents when practical. Prints of each drawing shall be submitted to the Facilities Manager for approval before proceeding with the work. Changes ordered by the Facilities Manager shall be made and revised prints submitted as above. The Facilities Manager's approval of drawings shall not relieve the contractor of responsibility for errors.

B. Primary Lines and Grades: The City of Milwaukee will mark two building corners along a line and will establish a benchmark, with a relative elevation, within close proximity to the site. Once established by the City, the contractor shall preserve all points and benchmark as long as needed during construction. The contractor will bear all costs associated with re-establishing points and benchmark.

C. Construction Lines and Grades: The contractor must bear sole responsibility for the correct transferal of all construction lines and grades from the primary lines and grades points. He shall take such measurements from existing work as may be necessary to insure the proper construction of his work.

D. Material Orders and Shipping Statements: The contractor shall furnish to the Facilities Manager at least two (2) copies of all material orders and shipping statements. Itemized weights of the materials and individual units of finished work shall be shown.

E. Weighing of Materials and Fabricated Units: The weighing of materials and fabricated units such as structural steel, casings, etc., when required, shall be done in the presence of the Commissioner's representative. The contractor shall be responsible for the satisfactory weighing of such materials and units.

F. Consignment and Delivery of Materials: The materials for the work shall be consigned to the contractor and he shall be responsible for the delivery of all materials required for the completion of the contract.

5. Samples and Tests:

A. Method of Sampling: Samples of the materials proposed or furnished for the work may be taken by the Commissioner at any time; at the point of manufacture, point of delivery or site of work. They will be selected, as far as practicable, in accordance with standard methods of sampling such materials as specified in the standard of the American Society for Testing Material. All sampling shall be done by authorized representatives of the Commissioner. Selections will be in an orderly and systematic manner, insuring samples representative of the lot.

B. A.S.T.M. Standards: Wherever the abbreviation A.S.T.M. is used in connection with the number of a standard specification, the specification referred to shall be the Standard of the American Society for Testing Materials, designated by that number, including all revisions in effect on the date of award of the contract. Should a revised or amended standard be issued by the American Society for Testing Materials which, in the opinion of the Commissioner, conflicts with or causes undesirable changes in the standards referred to herein, the Commissioner reserves the right, by means of addenda to the project manual, to continue

under the provisions of the pertinent standard referred to herein.

C. Cost of Test Specimens and Samples: All test specimens of metals and all samples of non-metals required for tests shall be furnished by the contractor without cost to the City.

D. Costs of Tests: All tests on test specimens of metals will be made at the expense of the contractor and the original test on samples of non-metals will be made at the expense of the City. In all cases, the testing procedure will be in accordance with Standard A.S.T.M. tests for such materials. Subsequent tests of non-metals requested by the contractor, when such tests are permitted by A.S.T.M. Specifications and approved by the Commissioner or subsequent tests ordered by the Commissioner will be made at the expense of the contractor.

6. Project Coordination:

A. Contractors are required, so far as possible, to arrange work and to dispose of materials so as not to interfere with the work or storage of materials of other contractors or City forces engaged upon the work.

B. Contractors shall give full cooperation to other trades and furnish any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

C. Where the work of a contractor will be installed in close proximity to the work of other trades, or where there is evidence that the work of a contractor will interfere with the work of other trades, he shall assist in working out space conditions to make satisfactory adjustments.

D. If a contractor installs work before coordinating it with other trades or so as to cause interference with work of other trades, he shall make necessary changes in his work to correct the condition without extra charge.

E. Contractors are required to join their work to that of others in a proper manner, and in accordance with the spirit of the plans and project manual, and to perform the work in the proper sequence in relation to that of other contractors, and as may be directed by the Project Inspector.

7. Supervision of Work:

A. Contractors shall furnish the services of an experienced engineer or superintendent.

B. He shall be constantly in charge of the installation of the work together with all subcontractors, skilled workers, helpers, and labor required to unload, transfer, erect, connect up, adjust, start, operate and test each system.

C. He shall be thoroughly acquainted with and be responsible for the various subcontractors' work so that it is properly coordinated and supervised to the satisfaction of the Commissioner of Public Works or his representative.

D. Upon written notice to a contractor of the lack of such coordination and supervision, the Commissioner of Public Works may authorize such services as may be required and deduct the cost of this service at an hourly rate of $60.00 per hour per worker from the contract for the work.

8. Technical Specifications and Drawings:

A. Governing order of Contract Documents:

1. The following provision modifies DPW General Specifications Item 2.1.3.1:

Anything mentioned in the Technical Specifications and not shown on the drawings or shown on the drawings and not mentioned in the Technical Specifications, shall be as if shown on or mentioned in both. In case of difference between drawings and Technical Specifications, the Technical Specifications shall govern. In case of any discrepancy in drawings or Technical Specifications, the matter shall be immediately submitted to Facilities Development and Management Section for decision. Said discrepancy shall not be adjusted by the contractor.

B. All contractors shall have complete sets of plans and project manuals on the job site at all times.

9. Safety Regulations:

All work shall be done in accordance with the safety requirements referenced in the International Building Code, as adopted and amended by the State of Wisconsin and OSHA.

10. Code Rules:

The rulings, regulations and laws of the following shall be complied with in the completion of this project:

International IBC Existing Building Code, as amended and adopted by the State of Wisconsin (Renovations/Remodeling)
International Building Code, as amended and adopted by the State of Wisconsin (New Construction)
Plumbing and Drainage Codes of the City of Milwaukee
Ordinances of the City of Milwaukee
National Board of Fire Underwriters
OSHA
NFPA
FAA
NEC
IEEE
UL

SECTION 00821: INSPECTION CHARGES

The contractor will be charged a fee for inspection for each and every day such inspection is required after the time allowed for completion has expired.

The amount of the fee for inspection shall be $325.00 per day.
Rev. 2/08

The time allowed for completion is stated in the Specific Official Notice and shall start with the date on the Notice to Proceed which will be sent to the contractor directly following the signing of the contract. The time allowed includes the time required for fabricating and procuring material and doing the work at the building site.

PREVAILING WAGE RATE DETERMINATION
Issued by the State of Wisconsin
Department of Workforce Development
Pursuant to s. 66.0903, Wis. Stats.
Issued On: 1/6/2014

DETERMINATION NUMBER:	201400011
EXPIRATION DATE:	Prime Contracts MUST Be Awarded or Negotiated On Or Before 12/31/2014. If NOT, You MUST Reapply.
PROJECT NAME:	ALL PUBLIC WORKS PROJECTS UNDER SEC 66.0903, STATS - CITY OF MILWAUKEE
PROJECT LOCATION:	MILWAUKEE CITY, MILWAUKEE COUNTY, WI
CONTRACTING AGENCY:	CITY OF MILWAUKEE-DEPT OF PUBLIC WORKS

CLASSIFICATION:	Contractors are responsible for correctly classifying their workers. Either call the Department of Workforce Development (DWD) with trade or classification questions or consult DWD's Dictionary of Occupational Classifications & Work Descriptions on the DWD website at: dwd.wisconsin.gov/er/prevailing_wage_rate/Dictionary/dictionary_main.htm.
OVERTIME:	Time and one-half must be paid for all hours worked: - over 10 hours per day on prevailing wage projects - over 40 hours per calendar week - Saturday and Sunday - on all of the following holidays: January 1; the last Monday in May; July 4; the 1st Monday in September; the 4th Thursday in November; December 25; - The day before if January 1, July 4 or December 25 falls on a Saturday; - The day following if January 1, July 4 or December 25 falls on a Sunday. Apply the time and one-half overtime calculation to whichever is higher between the Hourly Basic Rate listed on this project determination or the employee's regular hourly rate of pay. Add any applicable Premium or DOT Premium to the Hourly Basic Rate before calculating overtime. A DOT Premium (discussed below) may supersede this time and one-half requirement.
FUTURE INCREASE:	When a specific trade or occupation requires a future increase, you MUST add the full hourly increase to the "TOTAL" on the effective date(s) indicated for the specific trade or occupation.
PREMIUM PAY:	If indicated for a specific trade or occupation, the full amount of such pay MUST be added to the "HOURLY BASIC RATE OF PAY" indicated for such trade or occupation, whevenever such pay is applicable.
DOT PREMIUM:	This premium only applies to highway and bridge projects owned by the Wisconsin Department of Transportation and to the project type heading "Airport Pavement or State Highway Construction." DO NOT apply the premium calculation under any other project type on this determination.
APPRENTICES:	Pay apprentices a percentage of the applicable journeyperson's hourly basic rate of pay and hourly fringe benefit contributions specified in this determination. Obtain the appropriate percentage from each apprentice's contract or indenture.
SUBJOURNEY:	Subjourney wage rates may be available for some of the trades or occupations indicated below with the exception of laborers, truck drivers and heavy equipment operators. Any employer interested in using a subjourney classification on this project MUST complete Form ERD-10880 and request the applicable wage rate from the Department of Workforce Development PRIOR to using the subjourney worker on this project.

This document **MUST BE POSTED** by the **CONTRACTING AGENCY** in at least one conspicuous and easily accessible place **on the site of the project** . A local governmental unit may post this document at the place normally used to post public notices if there is no common site on the project. This document **MUST** remain posted during the entire time any worker is employed on the project and **MUST** be physically incorporated into the specifications and all contracts and subcontracts. If you have any questions, please write to the Equal Rights Division, Labor Standards Bureau, P.O. Box 8928, Madison, Wisconsin 53708 or call (608) 266-6861.

The following statutory provisions apply to local governmental unit projects of public works and are set forth below pursuant to the requirements of s. 66.0903(8), Stats.

s. 66.0903 (1) (f) & s. 103.49 (1) (c) "PREVAILING HOURS OF LABOR" for any trade or occupation in any area means 10 hours per day and 40 hours per week and may not include any hours worked on a Saturday or Sunday or on any of the following holidays:

1. January 1.
2. The last Monday in May.
3. July 4.
4. The first Monday in September.
5. The 4th Thursday in November.
6. December 25.
7. The day before if January 1, July 4 or December 25 falls on a Saturday.
8. The day following if January 1, July 4 or December 25 falls on a Sunday.

s. 66.0903 (10) RECORDS; INSPECTION; ENFORCEMENT.
(a) Each contractor, subcontractor, or contractor's or subcontractor's agent performing work on a project of public works that is subject to this section shall keep full and accurate records clearly indicating the name and trade or occupation of every person performing the work described in sub. (4) and an accurate record of the number of hours worked by each of those persons and the actual wages paid for the hours worked.

s. 66.0903 (11) LIABILITY AND PENALTIES.
(a) 1. Any contractor, subcontractor, or contractor's or subcontractor's agent who fails to pay the prevailing wage rate determined by the department under sub. (3) or who pays less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor is liable to any affected employee in the amount of his or her unpaid wages or his or her unpaid overtime compensation and in an additional amount as liquidated damages as provided under subd. 2., 3., whichever is applicable.
2. If the department determines upon inspection under sub. (10) (b) or (c) that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the department shall order the contractor to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages within a period specified by the department in the order.
3. In addition to or in lieu of recovering the liability specified in subd. 1. as provided in subd. 2., any employee for and in behalf of that employee and other employees similarly situated may commence an action to recover that liability in any court of competent jurisdiction. If the court finds that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the court shall order the contractor, subcontractor, or agent to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages.
5. No employee may be a party plaintiff to an action under subd. 3. unless the employee consents in writing to become a party and the consent is filed in the court in which the action is brought. Notwithstanding s. 814.04 (1), the court shall, in addition to any judgment awarded to the plaintiff, allow reasonable attorney fees and costs to be paid by the defendant.

BUILDING OR HEAVY CONSTRUCTION

Includes sheltered enclosures with walk-in access for the purpose of housing persons, employees, machinery, equipment or supplies and non-sheltered work such as canals, dams, dikes, reservoirs, storage tanks, etc. A sheltered enclosure need not be "habitable" in order to be considered a building. The installation of machinery and/or equipment, both above and below grade level, does not change a project's character as a building. On-site grading, utility work and landscaping are included within this definition. Residential buildings of four (4) stories or less, agricultural buildings, parking lots and driveways are NOT included within this definition.

SKILLED TRADES

Fringe Benefits Must Be Paid On All Hours Worked

CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
101	Acoustic Ceiling Tile Installer Future Increase(s): Add $1.25/hr on 6/2/2014.	33.68	19.81	53.49
102	Boilermaker	31.91	26.47	58.38
103	Bricklayer, Blocklayer or Stonemason Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year’s Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	35.37	18.00	53.37
104	Cabinet Installer	30.48	15.90	46.38
105	Carpenter Future Increase(s): Add $1.25/hr on 6/2/2014. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	33.68	19.81	53.49
106	Carpet Layer or Soft Floor Coverer	32.93	19.71	52.64
107	Cement Finisher	32.07	17.53	49.60
108	Drywall Taper or Finisher	29.87	19.99	49.86
109	Electrician Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year’s Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.82	22.61	55.43
110	Elevator Constructor	43.21	26.06	69.27
111	Fence Erector	16.00	3.33	19.33
112	Fire Sprinkler Fitter	38.50	19.65	58.15
113	Glazier	34.19	18.25	52.44
114	Heat or Frost Insulator	33.68	24.31	57.99
115	Insulator (Batt or Blown)	15.00	9.50	24.50

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
116	Ironworker Future Increase(s): Add $.80/hr on 6/1/2014. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	30.52	23.47	53.99
117	Lather	32.93	19.81	52.74
118	Line Constructor (Electrical)	38.25	17.63	55.88
119	Marble Finisher	26.89	19.18	46.07
120	Marble Mason	35.80	16.87	52.67
121	Metal Building Erector	22.05	8.08	30.13
122	Millwright	28.53	24.98	53.51
123	Overhead Door Installer	20.95	4.94	25.89
124	Painter	29.52	18.84	48.36
125	Pavement Marking Operator	30.00	0.00	30.00
126	Piledriver Premium Increase(s): Add $.65/hr for Piledriver Loftsman; Add $.75/hr for Sheet Piling Loftsman. DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	29.56	25.71	55.27
127	Pipeline Fuser or Welder (Gas or Utility)	31.82	19.74	51.56
129	Plasterer	31.56	18.18	49.74
130	Plumber	37.97	17.30	55.27
132	Refrigeration Mechanic	39.26	19.30	58.56
133	Roofer or Waterproofer	29.40	17.05	46.45
134	Sheet Metal Worker	36.17	18.04	54.21
135	Steamfitter Future Increase(s): Add $1.70/hr on 6/1/2014.	39.76	21.09	60.85
137	Teledata Technician or Installer Future Increase(s): Add $.85/hr on 6/1/2014; Add $.86/hr on 6/1/2015. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year’s Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	24.89	17.15	42.04

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
138	Temperature Control Installer	17.39	4.18	21.57
139	Terrazzo Finisher	26.89	19.18	46.07
140	Terrazzo Mechanic	30.20	18.42	48.62
141	Tile Finisher	23.85	17.18	41.03
142	Tile Setter	29.45	16.30	45.75
143	Tuckpointer, Caulker or Cleaner	34.57	16.42	50.99
144	Underwater Diver (Except on Great Lakes)	34.48	15.90	50.38
146	Well Driller or Pump Installer	25.32	15.65	40.97
147	Siding Installer	25.92	18.04	43.96
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	29.16	14.34	43.50
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	30.60	14.86	45.46
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	26.78	13.63	40.41
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	24.86	12.97	37.83
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	28.74	17.27	46.01

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	33.82	17.60	51.42
203	Three or More Axle	18.50	18.42	36.92
204	Articulated, Euclid, Dumptor, Off Road Material Hauler	28.32	16.11	44.43
205	Pavement Marking Vehicle	18.50	18.42	36.92
207	Truck Mechanic	18.50	18.42	36.92

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer Premium Increase(s): Add $.11 for mortar mixer, fork lift operator, air and electric equipment and power buggy operators; Add $.22 for jackhammer operator, certified welder, gunite machineman.	28.31	16.62	44.93
302	Asbestos Abatement Worker	19.00	0.00	19.00
303	Landscaper	14.28	8.24	22.52
310	Gas or Utility Pipeline Laborer (Other Than Sewer and Water)	19.78	17.04	36.82
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased) Premium Increase(s): DOT PREMIUMS: Pay two times the hourly basic rate on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	17.71	16.01	33.72
314	Railroad Track Laborer	13.50	4.06	17.56
315	Final Construction Clean-Up Worker	28.31	16.62	44.93

HEAVY EQUIPMENT OPERATORS
SITE PREPARATION, UTILITY OR LANDSCAPING WORK ONLY

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
501	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Milling Machine; Boring Machine (Directional, Horizontal or Vertical); Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Backhoe (Track Type) Having a Mfgr's Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Crane, Shovel, Dragline, Clamshells; Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Grader or Motor Patrol; Master Mechanic; Mechanic or Welder; Robotic Tool Carrier (With or Without Attachments); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Tractor (Scraper, Dozer, Pusher, Loader); Trencher (Wheel Type or Chain Type Having Over 8 Inch Bucket). Future Increase(s): Add $1.00/hour 6/2/2014; Add $1.50/hour 6/1/2015; Add $1.60/hour 5/30/2016.	34.07	18.10	52.17

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
502	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Environmental Burner; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Jeep Digger; Screed (Milling Machine); Skid Rig; Straddle Carrier or Travel Lift; Stump Chipper; Trencher (Wheel Type or Chain Type Having 8 Inch Bucket & Under). Future Increase(s): Add $1.00/hour 6/2/2014; Add $1.50/hour 6/1/2015; Add $1.60/hour 5/30/2016.	34.07	18.10	52.17
503	Air Compressor (&/or 400 CFM or Over); Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Greaser; High Pressure Utility Locating Machine (Daylighting Machine); Mulcher; Oiler; Post Hole Digger or Driver; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack.	30.82	18.96	49.78
504	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	38.80	18.98	57.78
505	Work Performed on the Great Lakes Including Crane or Backhoe Operator; Assistant Hydraulic Dredge Engineer; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder; 70 Ton & Over Tug Operator.	38.80	18.98	57.78
506	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	34.50	18.98	53.48
507	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	34.50	18.98	53.48

HEAVY EQUIPMENT OPERATORS
EXCLUDING SITE PREPARATION, UTILITY, PAVING LANDSCAPING WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
508	Boring Machine (Directional); Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add $1.25/hr on 6/1/2014; Add $1.55/hr on 6/1/2015. Premium Increase(s): Crane Operators with CCO certification add $.50/hr. Cranes with boom length over 200 ft. not exceeding 300 ft. OR lifting capacity over 200 ton not exceeding 300 ton add $.50/hr. Over 300 ton OR 300 ft. add $.01/hr. per foot OR ton whichever is greater.	40.36	19.15	59.51
509	Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Boring Machine (Horizontal or Vertical); Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Pile Driver; Versi Lifts, Tri-Lifts & Gantrys (20,000 Lbs. & Over). Future Increase(s): Add $1.25/hr on 6/1/2014; Add $1.55/hr on 6/1/2015. Premium Increase(s): Crane Operators with CCO certification add $.50/hr.	39.86	19.15	59.01
510	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Dredge (NOT Performing Work on the Great Lakes); Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Hydro-Blaster (10,000 PSI or Over); Milling Machine; Skid Rig; Traveling Crane (Bridge Type). Future Increase(s): Add $1.25/hr on 6/1/2014; Add $1.55/hr on 6/1/2015. Premium Increase(s): Crane Operators with CCO certification add $.50/hr.	39.36	19.15	58.51

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
511	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Environmental Burner; Gantrys (Under 20,000 Lbs.); Grader or Motor Patrol; High Pressure Utility Locating Machine (Daylighting Machine); Manhoist; Material or Stack Hoist; Mechanic or Welder; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tining or Curing Machine; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add $1.25/hr on 6/1/2014; Add $1.55/hr on 6/1/2015.	38.67	19.15	57.82
512	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Grout Pump; Hoist (Tugger, Automatic); Industrial Locomotives; Jeep Digger; Lift Slab Machine; Mulcher; Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames. Future Increase(s): Add $1.25/hr on 6/1/2014; Add $1.55/hr on 6/1/2015.	31.64	19.15	50.79
513	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Boatmen (NOT Performing Work on the Great Lakes); Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Elevator; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Forklift; Generator (&/or 150 KW or Over); Greaser; Heaters (Mechanical); Loading Machine (Conveyor); Oiler; Post Hole Digger or Driver; Prestress Machine; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $1.25/hr on 6/1/2014; Add $1.55/hr on 6/1/2015.	31.64	19.15	50.79
514	Gas or Utility Pipeline, Except Sewer & Water (Primary Equipment).	36.34	21.14	57.48
515	Gas or Utility Pipeline, Except Sewer & Water (Secondary Equipment). Future Increase(s): Add $1.60/hr on 06/01/2014; Add $1.65/hr on 06/01/2015	33.26	18.55	51.81
516	Fiber Optic Cable Equipment Future Increase(s): Add $1.75/hr on 02/01/2014.	27.89	17.20	45.09

SEWER, WATER OR TUNNEL CONSTRUCTION

Includes those projects that primarily involve public sewer or water distribution, transmission or collection systems and related tunnel work (excluding buildings).

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
103	Bricklayer, Blocklayer or Stonemason Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	35.10	18.40	53.50
105	Carpenter Future Increase(s): Add $1.25/hr on 6/2/2014. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	33.68	19.81	53.49
107	Cement Finisher Future Increase(s): Add $1.87 on 6/1/14; Add $1.87 on 6/1/15; Add $1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	33.51	16.13	49.64
109	Electrician Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.82	22.61	55.43
111	Fence Erector	16.00	3.33	19.33
116	Ironworker	31.25	19.46	50.71
118	Line Constructor (Electrical)	38.25	17.63	55.88
125	Pavement Marking Operator	16.00	7.35	23.35
126	Piledriver	30.98	15.90	46.88
130	Plumber	33.75	14.07	47.82
135	Steamfitter	37.76	19.99	57.75
137	Teledata Technician or Installer	24.75	16.08	40.83

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
143	Tuckpointer, Caulker or Cleaner	34.57	16.42	50.99
144	Underwater Diver (Except on Great Lakes)	38.80	18.98	57.78
146	Well Driller or Pump Installer	25.32	15.65	40.97
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	29.16	14.34	43.50
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	30.60	14.86	45.46
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	26.78	13.63	40.41
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	24.86	12.97	37.83
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.04	11.74	32.78

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	30.00	15.00	45.00
203	Three or More Axle	16.00	7.35	23.35
204	Articulated, Euclid, Dumptor, Off Road Material Hauler	32.89	18.96	51.85
205	Pavement Marking Vehicle	16.00	7.35	23.35
207	Truck Mechanic	16.00	7.35	23.35

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer Premium Increase(s): Add $1.92 for bottomman; Add $2.03 for concrete manhole builder, bracer, jointman, or pipelayer; Add $4.83 for blaster. Add $2.00 for all tunnel work under 15 lbs. compressed air; Add $2.00 for 0-30 lbs. compressed air; Add $3.00 for over 30 lbs. compressed air.	28.84	17.12	45.96
303	Landscaper	25.28	11.46	36.74
304	Flagperson or Traffic Control Person	17.41	10.10	27.51
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	17.69	15.50	33.19
314	Railroad Track Laborer	13.50	4.06	17.56

HEAVY EQUIPMENT OPERATORS
SEWER, WATER OR TUNNEL WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
521	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Master Mechanic; Pile Driver. Future Increase(s): Add $1.05/hr on 6/2/2014; Add $1.55/hr on 6/1/2015. Premium Increase(s): Add $.25/hr for operating tower crane.	36.84	19.45	56.29
522	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Spreader & Distributor; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Dredge (NOT Performing Work on the Great Lakes); Milling Machine; Skid Rig; Telehandler; Traveling Crane (Bridge Type). Future Increase(s): Add $1.05/hr on 6/2/2014; Add $1.55/hr on 6/1/2015. Premium Increase(s): Add $.25/hr for operating tower crane.	36.06	19.45	55.51
523	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Boring Machine (Horizontal or Vertical); Bulldozer or Endloader (Over 40 hp); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Manhoist; Material or Stack Hoist; Mechanic or Welder; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add $1.05/hr on 6/2/2014; Add $1.55/hr on 6/1/2015. Premium Increase(s): Add $.25/hr for operating tower crane.	35.11	19.45	54.56

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
524	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Environmental Burner; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Hoist (Tugger, Automatic); Grout Pump; Jeep Digger; Lift Slab Machine; Mulcher; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Tining or Curing Machine; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames. Future Increase(s): Add $1.05/hr on 6/2/2014; Add $1.55/hr on 6/1/2015. Premium Increase(s): Add $.25/hr for operating tower crane.	35.11	19.45	54.56
525	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Loading Machine (Conveyor); Post Hole Digger or Driver; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack.	30.19	20.94	51.13
526	Boiler (Temporary Heat); Forklift; Greaser; Oiler.	30.44	19.10	49.54
527	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	38.80	18.98	57.78
528	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	38.80	18.98	57.78
529	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	34.50	18.98	53.48
530	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under), Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	34.50	18.98	53.48

AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION

Includes all airport projects (excluding buildings) and all projects awarded by the Wisconsin Department of Transportation (excluding buildings).

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
103	Bricklayer, Blocklayer or Stonemason	35.80	16.87	52.67
105	Carpenter Future Increase(s): Add $1.25/hr on 6/2/2014. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	33.68	19.81	53.49
107	Cement Finisher Future Increase(s): Add $1.87 on 6/1/14; Add $1.87 on 6/1/15; Add $1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	31.56	18.53	50.09
109	Electrician Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year’s Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.82	22.61	55.43
111	Fence Erector	16.00	3.33	19.33
116	Ironworker	30.51	23.23	53.74
118	Line Constructor (Electrical)	38.25	17.63	55.88
124	Painter	21.87	11.37	33.24
125	Pavement Marking Operator	30.00	0.00	30.00
126	Piledriver	27.67	25.64	53.31
133	Roofer or Waterproofer	29.40	15.55	44.95
137	Teledata Technician or Installer	24.75	16.08	40.83
143	Tuckpointer, Caulker or Cleaner	34.57	16.42	50.99
144	Underwater Diver (Except on Great Lakes)	34.48	15.90	50.38

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	34.43	15.24	49.67
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	30.60	15.07	45.67
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	26.78	13.58	40.36
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	24.86	12.97	37.83
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.04	11.74	32.78

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	34.22	19.90	54.12
203	Three or More Axle	25.24	15.20	40.44
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add $1.75/hr on 6/1/14; Add $1.25/hr on 6/1/15; Add $1.30/hr on 6/1/16; Add $1.25/hr on 6/1/17. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	29.27	20.40	49.67
205	Pavement Marking Vehicle	25.24	15.20	40.44
206	Shadow or Pilot Vehicle	34.22	19.90	54.12
207	Truck Mechanic	25.24	15.20	40.44

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer Future Increase(s): Add $1.60/hr on 6/1/2014. Premium Increase(s): Add $.15/hr for air tool operator, joint sawer and filler (pavement), vibrator or tamper operator (mechanical hand operated), chain saw operator and demolition burning torch laborer; Add $.35/hr for bituminous worker (raker and luteman), formsetter (curb, sidewalk and pavement) and strike off man; Add $.50/hr for line and grade specialist; Add $.65/hr for blaster and powderman; Add $2.01/hr for topman; Add $2.46/hr for bottomman; Add $3.23/hr for pipelayer. / DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	26.06	19.43	45.49
302	Asbestos Abatement Worker	19.00	0.00	19.00
303	Landscaper Future Increase(s): Add $1.60/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	26.06	19.43	45.49
304	Flagperson or Traffic Control Person Future Increase(s): Add $1.60/hr on 6/1/2014. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year’s Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	22.55	19.43	41.98

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	17.69	15.50	33.19
314	Railroad Track Laborer	13.50	4.06	17.56

HEAVY EQUIPMENT OPERATORS
AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
531	Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Traveling Crane (Bridge Type). Future Increase(s): Add $1.75/hr on 6/1/2014; Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	36.72	20.40	57.12
532	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs., & Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add $1.75/hr on 6/1/2014; Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	36.22	20.40	56.62

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
533	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boatmen (NOT Performing Work on the Great Lakes); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, VIbratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane WIth a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. Future Increase(s): Add $1.75/hr on 6/1/2014; Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	35.72	20.40	56.12

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
534	Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or WIthout Attachments); Telehandler; Tining or Curing Machine. Future Increase(s): Add $1.75/hr on 6/1/2014; Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	35.46	20.40	55.86
535	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $1.75/hr on 6/1/2014; Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	35.17	20.40	55.57
536	Fiber Optic Cable Equipment.	26.69	16.65	43.34
537	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	38.80	18.98	57.78
538	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	38.80	18.98	57.78

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
539	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	34.50	18.98	53.48
540	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks-Great Lakes ONLY.	34.50	18.98	53.48

LOCAL STREET OR MISCELLANEOUS PAVING CONSTRUCTION

Includes roads, streets, alleys, trails, bridges, paths, racetracks, parking lots and driveways (except residential or agricultural), public sidewalks or other similar projects (excluding projects awarded by the Wisconsin Department of Transportation).

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
103	Bricklayer, Blocklayer or Stonemason	35.80	16.87	52.67
105	Carpenter	32.93	19.99	52.92
107	Cement Finisher	30.09	17.53	47.62
109	Electrician	31.27	22.81	54.08
111	Fence Erector	16.00	3.33	19.33
116	Ironworker	30.51	22.97	53.48
118	Line Constructor (Electrical)	38.25	17.63	55.88
124	Painter	29.52	18.84	48.36
125	Pavement Marking Operator	30.00	0.00	30.00
126	Piledriver	29.06	25.46	54.52
133	Roofer or Waterproofer	29.40	15.55	44.95
137	Teledata Technician or Installer	24.75	16.08	40.83
143	Tuckpointer, Caulker or Cleaner	34.57	16.42	50.99
144	Underwater Diver (Except on Great Lakes)	38.80	18.98	57.78
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	34.43	15.24	49.67
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	30.60	14.86	45.46
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	26.78	13.63	40.41
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	24.86	12.97	37.83
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.04	11.74	32.78

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	30.00	15.00	45.00

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
203	Three or More Axle	18.00	0.00	18.00
204	Articulated, Euclid, Dumptor, Off Road Material Hauler	32.89	18.96	51.85
205	Pavement Marking Vehicle	18.00	0.00	18.00
206	Shadow or Pilot Vehicle	30.00	15.00	45.00
207	Truck Mechanic	18.00	0.00	18.00

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer	23.07	18.07	41.14
303	Landscaper Future Increase(s): Add $1.60/hr on 6/1/14. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	29.04	14.63	43.67
304	Flagperson or Traffic Control Person	17.41	10.10	27.51
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	17.69	15.50	33.19
314	Railroad Track Laborer	13.50	4.06	17.56

HEAVY EQUIPMENT OPERATORS
CONCRETE PAVEMENT OR BRIDGE WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
541	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add $1.75/hr on 6/1/2014; Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	36.72	20.40	57.12
542	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Crane, Tower Crane Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add $1.75/hr on 6/1/2014; Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	36.22	20.40	56.62

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
543	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. Future Increase(s): Add $1.75/hr on 6/1/2014; Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	35.72	20.40	56.12
544	Backfiller; Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Jeep Digger; Joint Sawer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (WIth or Without Attachments); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine.	33.96	19.79	53.75
545	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.	30.32	18.46	48.78
546	Fiber Optic Cable Equipment.	26.69	16.65	43.34

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
547	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	38.80	18.98	57.78
548	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	38.80	18.98	57.78
549	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or more); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	34.50	18.98	53.48
550	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	34.50	18.98	53.48

HEAVY EQUIPMENT OPERATORS
ASPHALT PAVEMENT OR OTHER WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
551	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads and/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.	39.16	19.10	58.26
552	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add $1.75/hr on 6/1/2014; Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	36.22	20.40	56.62

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
553	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Laser/Screed; Concrete Slipform Placer Curb & Gutter Machine; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames.	33.67	19.55	53.22
554	Backfiller; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self-Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler.	33.67	19.55	53.22
555	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $1.75/hr on 6/1/2014; Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT's website for details about the applicability of this night work premium at: http://roadwaystandards.dot.wi.gov/hcci/labor-wages-eeo/index.shtm.	35.17	20.40	55.57
556	Fiber Optic Cable Equipment.	26.69	16.65	43.34

RESIDENTIAL OR AGRICULTURAL CONSTRUCTION

Includes single family houses or apartment buildings of no more than four (4) stories in height and all buildings, structures or facilities that are primarily used for agricultural or farming purposes, excluding commercial buildings. For classification purposes, the exterior height of a residential building, in terms of stories, is the primary consideration. All incidental items such as site work, driveways, parking lots, private sidewalks, private septic systems or sewer and water laterals connected to a public system and swimming pools are included within this definition. Residential buildings of five (5) stories and above are NOT included within this definition.

SKILLED TRADES

Fringe Benefits Must Be Paid On All Hours Worked

CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
101	Acoustic Ceiling Tile Installer Future Increase(s): Add $1.25/hr on 6/2/2014.	33.68	19.81	53.49
102	Boilermaker	26.00	4.73	30.73
103	Bricklayer, Blocklayer or Stonemason	23.74	8.31	32.05
104	Cabinet Installer	25.00	0.00	25.00
105	Carpenter	21.00	15.34	36.34
106	Carpet Layer or Soft Floor Coverer	13.00	0.00	13.00
107	Cement Finisher	23.50	13.19	36.69
108	Drywall Taper or Finisher	25.00	5.00	30.00
109	Electrician	25.00	2.43	27.43
110	Elevator Constructor	43.21	26.06	69.27
111	Fence Erector	18.00	1.38	19.38
112	Fire Sprinkler Fitter	52.82	5.54	58.36
113	Glazier	37.13	12.29	49.42
114	Heat or Frost Insulator	30.00	0.00	30.00
115	Insulator (Batt or Blown)	17.00	0.50	17.50
116	Ironworker	31.25	19.46	50.71
117	Lather	21.00	15.34	36.34
119	Marble Finisher	26.89	19.18	46.07
120	Marble Mason	23.74	8.31	32.05
121	Metal Building Erector	17.00	3.82	20.82
123	Overhead Door Installer	19.00	0.13	19.13
124	Painter	29.52	2.52	32.04

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
125	Pavement Marking Operator	30.00	0.00	30.00
129	Plasterer	22.00	0.00	22.00
130	Plumber	37.97	19.84	57.81
132	Refrigeration Mechanic	19.75	8.83	28.58
133	Roofer or Waterproofer	29.40	16.35	45.75
134	Sheet Metal Worker	25.92	13.12	39.04
135	Steamfitter	31.72	16.10	47.82
137	Teledata Technician or Installer	24.75	10.87	35.62
138	Temperature Control Installer	18.00	0.50	18.50
139	Terrazzo Finisher	26.89	19.18	46.07
140	Terrazzo Mechanic	30.20	18.42	48.62
141	Tile Finisher	23.77	16.50	40.27
142	Tile Setter	30.00	0.00	30.00
143	Tuckpointer, Caulker or Cleaner	28.00	0.00	28.00
146	Well Driller or Pump Installer	27.60	0.00	27.60
147	Siding Installer	16.00	0.62	16.62

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	17.25	4.56	21.81
203	Three or More Axle	23.17	13.32	36.49
205	Pavement Marking Vehicle	23.17	13.32	36.49
207	Truck Mechanic	19.00	1.85	20.85

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer	18.00	10.64	28.64
302	Asbestos Abatement Worker	17.00	3.86	20.86

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
303	Landscaper	14.20	1.37	15.57
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	17.69	15.50	33.19
315	Final Construction Clean-Up Worker	28.32	16.11	44.43

HEAVY EQUIPMENT OPERATORS
RESIDENTIAL OR AGRICULTURAL CONSTRUCTION

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
557	Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type); Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, VIbratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & DIstributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Crane, Shovel, Dragline, Clamshells; Forestry Equipment, TImbco, Tree Shear, Tub Grinder, Processor; Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type); WInches & A-Frames.	22.00	6.89	28.89
558	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Backfiller; Belting, Burlap, Texturing Machine; Boiler (Temporary Heat); Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & LIght Equipment); Concrete Finishing Machine (Road Type); Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Jeep Digger; Lift Slab Machine; Mulcher; Oiler; Post Hole Digger or Driver; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Roller (Rubber Tire, 5 Tons or Under); Screed (Milling Machine); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Stump Chipper; Telehandler; Vibratory Hammer or Extractor, Power Pack.	16.15	1.93	18.08

********** END OF RATES **********

SECTION 00850: DRAWING SCHEDULE

The following listed drawings accompany and form a part of the project contract documents along with this project manual and generally illustrate the nature of the work.

Sheet No.	Title
T-1	Title Sheet
FP-1	Floor Plans – Fire Suppression
FP-2	Floor Plans – Fire Suppression
FP-3	Floor Plans – Fire Suppression
FP-4	Floor Plans – Fire Suppression
FP-5	Fire Suppression – Details
AR-1	Floor Plans & Details – Architectural
M-1	Partial Plans – Basement & First Floor – Fire Pump Room Ventilation
E-1	Floor Plans – Electrical Power
E-2	Floor Plans – Electrical Power
E-3	Floor Plans – Electrical Power
E-4	Floor Plans – Electrical Lighting
E-5	Electrical One-Line Diagram, Riser Diagram & Schedules

SECTION 01010: SUMMARY OF WORK:

1. SCOPE:

A. Index:

1. Scope
2. Project Description
3. Alternate Deduct Items
4. Work by Others
5. Scheduling of Work

2. PROJECT DESCRIPTION:

A. In general, the project includes all site and building work (unless otherwise noted) necessary for installation of a new wet and pre-action fire suppression system, including; fire pumping and controller, sprinkler riser and distribution piping systems, sprinkler heads and detection systems, and pre-action cabinet and control panels. Construct a new fire pump room with mechanical ventilation, associated electrical wiring, lighting, etc. to constitute a complete installation for the Police Evidence Warehouse Building, as described and shown in the Plans and as specified herein.

B. The City of Milwaukee Police Department (MPD) will occupy the Police Evidence Warehouse building during entire period of construction to conduct normal operations. Cooperate with the City/MPD during project construction operation to minimize conflicts and facilitate City/MPD's normal operations. Contractor shall, at all times, conduct operation to ensure least inconvenience to the City/MPD, other contractors, general public, and the Police Evidence Warehouse operation.

C. The contractor must coordinate all work activities with the City/MPD, utilities, and all other work forces on site.

D. It is also understood that the submittal of a proposal shall include furnishing all labor, materials, equipment, and incidentals necessary for completion of the work required, including that which may not be directly shown on the drawings or in the specifications, but are necessary for proper operation and approval.

E. Examine Documents and Visit Site:

1. Before submitting a bid proposal, bidders should carefully examine the drawings and specifications; visit the site of work; fully inform themselves as to all existing conditions and limitations including those of labor; and shall include in the bid proposal a sum sufficient to cover the cost of all items contemplated by the construction documents.

2. Each sub-bidder further represents that he has inspected the site of the proposed work to ascertain any obstacles that might be encountered and other matters and conditions relevant to this work.

3. The nature of the work required demands thorough review of all drawings and the project manual, and diligent and careful site inspection by all prospective sub-bidders as a means of determining the extent of work and conditions under which the work is to

be performed.

4. Additional charges will not be as considered for work which, prior to bidding, could reasonably be inferred as appropriate by examination of the drawings and specifications, visiting the site, and closely reviewing the work as indicated above. No representations as to subsurface conditions are made.

F. The following outline is intended to serve as a general guide only, and not as a complete listing of work, operations, or materials. Consult the Table of Contents for complete listing of items included. Scope of work includes but is not limited to the following:

1. Furnish and install new wet and pre-action fire suppression and alarm system for the Police Evidence Warehouse building, except as noted otherwise in this Summary of the Work.

2. Furnish and install new fire pumping and pump controller system to serve new fire suppression distribution sprinkler system, as shown on Plans.

3. Furnish and install lighting and 120-volt branch circuit wiring for convenience outlets, fire suppression control panels, etc., as shown on Plan and where specified.

4. Furnish "as-built" drawings and wiring diagrams.

5. Remove all old material, unused and abandoned conduit, and wiring. Seal all existing floor or wall penetrations to meet hour fire rating where specified on Plans.

6. Furnish and install new concrete block walls for new fire pump room enclosure on the basement level of facility, as shown on Plans and Specifications Divisions 1 through 9.

7. Furnish and install air ventilating system as specified to serve new fire pump room.

8. Provide warranty, start-up service, O & M Manuals, record as-built drawings and all other specified documentation.

9. All required approvals and necessary permits and fees shall be obtained for this project.

10. Attend regularly scheduled construction meeting until project completion.

11. <u>Demolition, Removal, and Disposal</u>:

    a. Contractor shall be responsible for all costs associated with demolition, removal, and disposal of indicated equipment and material.

    b. Contractor shall be responsible for repairing any damage caused to building or building components through demolition and removal process.

    c. Contractor shall follow all Wisconsin Department of Natural Resources and Environmental Protection Agency, as well as any other state or national regulations, regarding disposal of equipment or materials removed from building.

12. Contractors shall maintain any special security procedures that are in place at the site.

13. Furnish and install new security system door access control and monitoring devices where shown on Plans and Specification Division 28. Access control and door monitoring shall be integrated into existing Access Control system.

14. Furnish and install new exhaust fan and duct modifications to existing ventilation system to serve new fire pump room as shown on Plans and Specification Division 15.

15. Provide all equipment, materials and labor necessary to install a new electrical service and power system to serve new fire pump equipment, including; fire and jockey pumps and controllers power. New lighting and branch circuits related to fire suppression systems shall be powered from existing electrical branch panels as shown on Plans and Specification Division 26.

16. Provide all equipment, materials, and labor necessary to modify the existing facility telephone system to service the fire pump room upgrades as shown on Plans and Specification Division 26.

17. Provide all equipment, materials and labor necessary to modify the existing fire alarm system for control and alarm requirements for the fire suppression system upgrades as shown on Plans and Specification Division 28.

18. Engage the service of a plumbing contractor to provide all labor and materials necessary to install a new water service to Police Evidence Warehouse building to serve new fire suppression wet system.

19. Engage the services of WE Energies to provide all labor and materials necessary to install a new overhead electric service to the Police Evidence Warehouse building for new fire suppression system fire pump and controller equipment.

3. <u>ALTERNATE DEDUCT ITEMS</u>

State the amount to be deducted from the Base Bid to perform all work and furnish all materials for the following items as denoted below;

A. Basement Level

a. Remove zone control valve and all wet pipe sprinkler system from Basement level. Provide capped outlet for future sprinkler connection at the location of the sprinkler zone control valve as indicated in Storage B-2. Remove fire tamper and flow switch monitoring from zone control valve. Note: sprinkler head and associated fire alarm work shall remain to serve freight elevator pit.

B. First Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in Garage #114. Remove monitoring of preaction control system and all associated preaction smoke and heat detectors.

b. Remove zone control valve and all wet pipe sprinkler system from First Floor level. Provide capped outlet off standpipe for future sprinkler connection at the location of the sprinkler zone control valve as indicated in Viewing #105. Remove fire tamper and flow

switch monitoring from zone control valve.

C. Mezzanine Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in Storage #M102. Remove monitoring of preaction control system and all associated preaction smoke detectors.

D. Second Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in Storage #202. Remove monitoring of preaction control system and all associated preaction smoke detectors.

E. Third Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in North Vault #304. Remove monitoring of preaction control system and all associated preaction smoke detectors.

F. Fourth Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in Storage #402. Remove monitoring of preaction control system and all associated preaction smoke detectors.

G. Fifth Floor Level

a. Remove all pre-action system components including; piping, sprinklers, pre-action cabinet and control panel. Provide capped outlet at standpipe for future connection of preaction system in Storage #502. Remove monitoring of preaction control system and all associated preaction smoke detectors.

b. Wet system piping, sprinklers, and detection in freight elevator shaft and Penthouse (Machine room) will be included under the base bid.

H. Preaction Valve Trim

a. Remove installation of pre-packaged preaction valve cabinet as indicated in Detail #1 on Sheet FP-5. Install preaction valve, valve trim, air compressor, air maintenance device, and releasing panel exposed. See Detail #2 on Sheet FP-5 for alternate preaction valve trim schematic.

4. <u>WORK BY OTHERS</u>:

A. None.

5. <u>SCHEDULING OF WORK</u>:

A. Within ten (10) business days after Notice to Proceed is issued, the contractor shall submit a construction schedule for approval. The schedule shall be made in sufficient detail to indicate sates of each significant operation. The schedule shall be such that the entire job will be

completed within the specified completion time. Contract shall submit the schedule in hard copy and electronic format using Microsoft Project or Primavera P6.

B. All work shall be done after 6:00 AM and before 3:30 PM on weekdays as the building will remain in operation and be occupied during construction.

C. Contractor shall notify DPW, ISD - Facilities Development and Management Section 48 hours in advance of commencement of any work on this project.

D. Site work is not to proceed without authorization from the owner or its engineer/consultant or before a Pre-Construction Meeting.

E. Contractor shall schedule and execute construction activities in a manner which minimizes disruption of operations. As such, construction activities shall be carried out in a contiguous fashion.

F. All work shall be completed within the time period designated in the contract documents.

G. Contractor shall protect existing equipment, floors, and walls from all construction debris and damage.

H. The contractor shall sign in and identify all personnel working at the site on a daily basis with the supervisor in charge at the site. All personnel will require MPD security clearance a minimum 24-hours prior to signing in for scheduled work at the site.

SECTION 01210: PROJECT MEETINGS

1. SCOPE:

A. Index:

1. Scope
2. Pre-Construction Meeting
3. Progress Meetings

2. PRE-CONSTRUCTION MEETING:

A. Soon after the award of the contract and prior to the start of construction, the contractor shall attend a pre-construction conference with representatives of the City.

B. The contractor shall have at the meeting responsible representatives from subcontractors who are to perform major work on the project.

C. The purpose of the meeting is to discuss in detail the plans and specifications. The discussion shall include:

1. Schedule
2. Equipment
3. Material Storage
4. Traffic Control
5. Inspection Requirements
6. Protection Procedures for the structure, adjacent facilities, environment, and personnel.
7. Hours of Work

D. The contractor shall submit the construction schedule to the architect/engineer at this meeting and a listing of subcontractors and their work. The contractor shall describe, in detail, when each portion of the work is expected to be accomplished. The subcontractors shall participate in the discussion. The architect/engineer will serve to interpret the contract documents should such questions arise.

E. Any other questions that the contractor or his subcontractors have about the work or its scheduling shall be raised at these meetings.

F. Requirements for contract administration and construction operations will be defined for participants.

G. The architect/engineer will determine time, date, and place of the meeting.

3. PROGRESS MEETINGS:

A. Bi-weekly meetings will be held for the purpose of coordinating and expediting the work.

B. Attendance at project meetings by the contractor is mandatory. These meetings shall also be attended by representatives of each subcontractor who is either working at the site or is affected by work being done at the site. The contractor shall submit an updated construction

schedule at these meetings and a short narrative should be written, describing the cause of any delays and intended action to remedy these delays.

C. Contractors shall give a verbal report of progress on the project, discuss the work schedule for the coming period, and present all conflicts, discrepancies, or other difficulties for resolution.

SECTION 01300: SUBMITTALS/PERMITS

1. SCOPE:

A. Index:

1. Scope
2. Submittals
3. Permits
4. Inspection

2. SUBMITTALS:

A. Comply with the requirements of the General Conditions and as follows:

1. Forward Submittals not more than 20 calendar days after the Notice to Proceed date. No work, as indicated on any shop drawing, samples, hardware list, etc., shall be started until those submittals have been reviewed and work authorized.

2. All submittals must be thoroughly reviewed by the prime contractor for conformance to contract documents, prior to submission to the City, or its agents, for review. Shop drawings and catalog information shall be stamped "Reviewed By" and signed by the contractor's reviewer. The prime contractor shall review all subcontractor submittals prior to submittal to the City for compliance with contract documents and to coordinate all work.

3. Include with each submittal a transmittal letter signed and dated by the prime contractor containing the following:

a. Name of Contractor
b. Name of Project
c. List of Submittals
d. Name of Manufacturer or Supplier
e. Additional information as required for the items being provided.

B. Shop Drawings, Catalog Information, Calculations, and Samples:

1. Shop Drawings: Submit one blue/black line print review. The City will notify the contractor in writing and return one copy marked "REVIEWED - NO EXCEPTIONS TAKEN" with minor or no notations. The City will also notify the contractor in writing and return one copy, along with comments, when the drawings are marked either "REJECTED" or "REVISE AND RESUBMIT". For those shop drawings, the contractor will be responsible for resubmitting a new print.

2. Catalog Information and Calculations: Submit four copies for City's record and additional numbers of copies required for the contractor's purpose. The City will notify the contractor in writing and return the contractor's copies, with or without notation,

marked either "REVIEWED - NO EXCEPTIONS TAKEN", "REVISE AND RESUBMIT", OR "REJECTED". Catalog information or calculations marked "REVISE AND RESUBMIT" or "REJECTED" must be resubmitted in the same quantities as originally required.

3. Samples: Submit two samples of requested materials for the City's records and additional samples, if desired, to be returned to the contractor. The City will notify the contractor in writing, whether the samples are approved or rejected. If they are rejected, new samples must be resubmitted as originally required.

4. Corrections or comments made on the submittals during the review do not relieve the contractor from compliance with requirements of the contract documents. The check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. Contractors are responsible for conforming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating their work with that of all other trades; and performing their work in a safe manner.

C. "Or Equal": Whenever the words "or equal" or similar term is used, it shall mean as determined by the Commissioner of Public Works or agent. All drawings, data and bulletins necessary to make an "or equal" determination shall be submitted to the Facilities Manager of Facilities Development and Management Section. Such review shall apply to design only and shall in no way relieve the contractor from the responsibilities as outlined in Item 2B above. Evaluation of "or equal" products will be made at the time of shop drawing submission. Any change required in design and coordination between all contractors, subcontractors, or trades due to the use of "or equal" materials shall become the contractor's responsibility. Any costs for detailed engineering reviews and/or any costs to incorporate "or equal" products will be borne by the contractor.

3. PERMITS:

A. The City of Milwaukee will provide the general building and occupancy permits.

B. Contractors shall obtain, from the City of Milwaukee Department of City Development and/or other government or private agencies, all special permits as may be necessary in their work.

C. Contractors shall obtain all permits to occupy or work in the public way as may be necessary for their work.

D. Contractors shall notify the City and/or appropriate utilities when making utility connections as part of the project.

4. INSPECTION:

A. Facilities Development and Management Section will provide daily inspection to verify compliance with contract documents, identify contractors and crews on the job, verify compliance with contract conditions (MWSBE, residency, wage requirements), and record job

progress and conditions.

Rev. 1/04

B. Contractors shall arrange with the Department of Neighborhood Services/Construction Trades Division and permit issuing agencies for all code compliance inspections as required by all permits including, but not limited to, the general building and all special permits issued by that agency.

C. Contractors shall arrange with the appropriate City agency for compliance inspections, as required, for all permits including, but not limited to, curb and pavement cuts and patches, and public way occupancy and utility connections.

REV 7/99

SECTION 01500: JOB SITE UTILITIES, FACILITIES, AND SECURITY

1. SCOPE:

A. Index:

1. Scope
2. Milwaukee Police Department Security Procedures
3. Building Security
4. Temporary or Trial Usage
5. Occupancy During Construction
6. Temporary hoists, Lifts
7. Temporary Ladders, Scaffolds
8. Electrical Power
9. Water
10. Toilet Facilities
11. Parking
12. Barricades and Signage
13. Construction Reference and Storage Area

2. MILWAUKEE POLICE DEPARTMENT SECURITY PROCEDURES:

A. All contractors, vendors, and visitors who intend to do business at any Milwaukee Police Department site must have a background check performed by the Milwaukee Police Department prior to any access. This includes all District stations, substations, outposts, warehouses, or offices occupied by the Police. In order to facilitate this directive and ensure the safety and security of our operations, the Milwaukee Police Department requests a two-week advance written notice before any work or “walk through” is scheduled.

B. Once notice is received and approved by the Building Maintenance Manager in charge, the Facilities Services Section will notify the shift commander of each specific area involved.

C. The Milwaukee Police Department further requires:

1. The contractor or vendor supply basic contact information regarding the company or firm (address, telephone number, contact name and title, etc.)

2. A 48-hour telephone or fax notice for all individuals expected to perform services so that background checks can be completed prior to the start of site work or “walk through”.

3. In order to facilitate the background check, provide the full name (including middle name), race, sex and date of birth of all individuals. If the name is common, (i.e. Jones, Smith, Johnson, etc.) the last four numbers of the individual’s social security number must also be submitted.

3. BUILDING SECURITY:

A. General

1. The City Hall Complex is open to the public from 8:00 a.m. until 4:45 p.m., Monday through

Friday excluding Holidays. It is essential that contractors and their City agents understand and abide by security policy. Any work performed at any time in the Mayor's Office, City Clerk, Treasurer, Budget, or City Attorney offices must be cleared in advance with representatives from those offices.

2. Outlying buildings are not generally open to the public. Contracted work in these buildings can take place at any time. It is essential that contractors and their City agents understand and abide by security policy.

B. Scope

At the beginning of any project, a copy of this policy and procedure statement will be added to specifications for bid consideration and shall be distributed at the pre-construction meeting. All City agents/officials responsible for engaging contractors, all contractors, and all sub-contractors shall be held responsible for following the procedures.

C. City Agents

Any City agent who commissions outside contractors to work in any of the facilities managed by DPW-Facilities Development and Management shall provide a completed Contractor Authorization form to DPW-Facilities no less than twenty-four (24) hours in advance of the work.

1. The completed form will be provided to the Security Operations Manager and the City Hall Information Center. The inspector or city agent managing the project will provide this information in conjunction with the contractor. If the work is completed in outlying buildings the City agent shall be responsible for gaining and controlling access in that facility.
2. All access requirements must be included on the Contractor Authorization form. Critical information includes a list of keys and/or access cards required. In addition, access to more secure areas shall be explicitly requested. Secure areas may require additional scrutiny. Work in secure areas will not commence until all necessary approvals have been obtained. More secure areas may include private offices, inventory rooms, mechanical areas, data rooms, etc. In most cases keys or access cards required to do work in the outlying buildings will be the responsibility of the Maintenance Technician or Construction Inspector. Keys or access cards needed for work in the City Hall Complex will be checked out by the Information Center, once approved.

D. Contractors

Contractors shall abide by City Security Policy and Procedures at all times during the scope of their participation in a project. Failure to comply will result in the contracted employee being escorted from the premises, and the resulting lost time and expense shall be deducted from the contractor's invoice or penalties of $50.00 per occurrence as determine by the contracting City agent/official.

1. All access should be arranged in advance through the City agent. Contractors shall enter and exit only through those doors designated by City agents (ex: the Market Street entrance to City Hall, doors established by the person responsible for access at the outlying buildings). All other exterior doors are locked and alarmed and are not to be used as delivery points unless the City agent/officials has been provided 24 hour notification to provide additional security coverage at that point while the delivery is in progress.

2. All of the contractor's employees and all of the employees of any sub-contractor shall be clearly identifiable as a contractor via uniform or clearly visible company picture ID.

3. Contractors will sign in on pre-approved forms and also wear City issued identification badges (in the City Hall Complex).

4. Keys or access cards will be signed out as necessary with approval from the City agent/official. The contractor must leave their drivers license. All keys, cards, and badges must be returned at the end of each shift before the contractor's driver license will be returned. Failure to do so will result in a $50.00 penalty for each occurrence.

5. Contractors shall not ask custodians or mechanics to unlock doors. All access should be provided in advance through the City agent/official. In the rare case where access is not provided, the City Hall operator may be contacted to assist in providing access. The contractor shall cooperate with security personnel at all times. The contractor should be prepared to allow searches of equipment when leaving and should remain only in the areas designated on the sign-in sheets. Security will question a contractor who has an identification badge that indicates a work area other than the area he or she is in.

6. If the contractor requires use of the loading dock in Upper Parking, 24 hour advanced notice shall be given to the City agent/official to make arrangements to provide additional security coverage while the delivery is in progress. The contractor or subcontractor shall meet the delivery driver and take delivery at that point. At no time shall a driver be allowed in the facilities without following the access procedure stated above.

7. If after hours work is required in the outlying buildings, all subcontractors and trades will arrange appropriate security and lock-up procedures with the contractor, in advance and in writing to the satisfaction of the City agent. Any work completed at night shall be left "open" for City inspection of the work. The contractor shall notify the City agent/official 24 hours in advance of after-hours work in writing, indicating the type of work to be done and the security measures to be taken by the contractor.

8. The contractor shall provide plywood door and window closures during construction to secure the structure from weather and damage from vandalism. The contractor is responsible to maintain the security of the space they are working during construction to the satisfaction of DPW-Facilities Development and Management and the City agent (if different).

9. If proper notification is not provided to the contractor, the subcontractor or trades shall be liable for any subsequent damage/vandalism/inspection cost etc. due to lack of security/inspection coordination.

10. Use of City materials is strictly prohibited unless pre-arranged through the City employee contact.

11. At no time shall any interior doors that control access or exterior doors be propped open.

4. <u>TEMPORARY OR TRIAL USAGE</u>:

The owner shall have the right to make temporary or trial usage of any mechanical device, machinery, apparatus, equipment, work, material or construction supplied under contract before final completion or acceptance of the work, and the same shall not be construed as evidence of acceptance of the work by the owner.

5. OCCUPANCY DURING CONSTRUCTION:

The owner will occupy the premises while work is in progress. Contractor is to coordinate his work as to not interfere with the owner's operation or compromise building security.

6. TEMPORARY HOISTS, LIFTS:

Contractors and subcontractors requiring hoists or lifts shall provide their own and remove upon completion of work.

7. TEMPORARY LADDERS, SCAFFOLDS:

E. Contractors and subcontractors requiring scaffolds, chutes, and ladders shall provide their own and remove them upon completion of work.

F. Each contractor shall furnish and maintain equipment such as fixed ladders, chutes, and the like as required for proper execution of their work.

8. ELECTRICAL POWER:

A. Contractor may use existing outlets for power. Contractor is to supply his own extension cords. All current used will be provided and paid by the City of Milwaukee.

B. OSHA regulations require that employers use either ground fault circuit interrupters or an assured equipment grounding conductor problem in addition to any other regulations for equipment grounding conductors.

9. WATER:

Contractor may use existing hose bibs for water. Contractor is to supply his own hoses. Contractor's hoses shall be leak free and contractor is to regulate the flow to limit it to project related use. The cost of the water will be paid for by the City.

10. TOILET FACILITIES:

Contractor may use existing toilet facilities in the building but will then be responsible to ensure that the facility is kept in a sanitary condition.

11. PARKING:

Contractor is responsible for parking of vehicles. No parking areas will be provided by the City.

12. BARRICADES AND SIGNAGE:

Contractor is to provide barricades and signage as required by OSHA and City/State Codes for their work.

13. CONSTRUCTION REFERENCE AND STORAGE AREA:

The contractor is to provide desks or other suitable surfaces for himself, his subcontractors, and the City Project Inspector for the purpose of viewing plans, project manuals, and other construction related documents. The contractor is also to provide filing cabinets or document boxes or other suitable containers for himself, his subcontractors, and the City Project Inspector for the purpose of storing plans, project manuals, shop drawings, and other construction related documents that he is required by this contract to keep on site.

SECTION 01505: CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SCOPE:

A. This section specifies requirements for salvaging, recycling and disposing of construction waste for purposes of protecting the environment and reducing project cost.

Requirements include the following:

1. Developing a Construction Waste Management Plan including waste management goals and provisions for waste reduction and recycling.
2. Implementing, monitoring and documenting the waste management plan.
3. Incorporating special programs.
4. Evaluating construction waste management.

1.2 RELATED DOCUMENTS AND SECTIONS:

A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related documents include the following

1. Section 01010 “Summary of Work”
2. Section 01300 “Submittal & Permits”
3. Section 001500 “Utilities, Facilities, and Security” for environmental-protection measures during construction.

1.3 PRECONSTRUCTION MEETING:

A. After award of Contract and prior to the commencement of the Work, schedule and conduct a meeting with the Owner and Architect to discuss the proposed Construction Waste Management Plan and to develop a mutual understanding regarding details of environmental protection.

1.4 CONSTRUCTION WASTE MANAGEMENT PLAN:

A. Construction Waste Management Plan

1. The purpose of the Construction Waste Management Plan is to identify construction waste reduction goals, identify targeted materials, and explain specific waste reduction actions to be taken, by whom, and when.
2. The Contractor shall develop a Construction Waste Management Plan for this Project within 15 working days after Contract award or prior to any waste removal. The Owner and the Architect will furnish the Contractor with information that will assist in the development of the Construction Waste Management Plan. Submit the Construction Waste Management Plan (include document/report form) to the Architect for approval prior to implementing the Plan.

B. Progress Documentation: Document solid waste disposal and diversion. Include the date of removal, type of waste removed, quantity by weight and volume, final destination and use (recycled, reused or landfilled), and net cost or income.

1. Document on the Form acceptable to the Owner and Architect.
2. With each Application for Payment, submit updated documentation identifying solid waste disposal and diversion.
3. With each Application for Payment, submit manifests, weight tickets, receipts and invoices identifying the Project and construction waste material.

C. Record Submittals: Submit the following:

1. Summary of solid waste disposal and diversion. Submit on form acceptable to the Owner and Architect.
2. End-of-Project recycling rates and landfill rates demonstrating the percentage of construction waste that was recycled or reused.

1.5 WASTE MANAGEMENT GOALS:

A. Develop Construction Waste Management Plan that results in end-of-Project rates for the reuse/recycling of **25%** percent by weight or volume of total waste generated by the Project. Record the total construction waste reduction goal on the Construction Waste Management Plan Form.

B. Reduce: The Project shall generate the least amount of waste and methods shall be used that minimize waste due to error, poor planning, breakage, mishandling, contamination, or similar factors. Promote the resourceful use of materials to the greatest extent possible.

C. Reuse: The Contractor and Subcontractors shall reuse materials to the greatest extent possible. Reuse includes the following:

1. Salvage reusable materials for resale, for reuse on this Project, or for storage for use on future projects.
2. Return reusable items (e.g., pallets or unused products) to the material suppliers.

D. Recycle: As many of the waste materials not able to be eliminated in the first place or salvaged for reuse shall be recycled. Waste disposal in landfills shall be minimized to greatest extent possible.

1.6 MATERIALS HANDLING AND SORTING:

A. Handling:

1. Materials that are contaminated prior to placing in collection containers shall be properly cleaned. Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling processes.
2. Cover materials with tarps and keep truckloads level so as to prevent spillage.
3. Arrange for collection by or delivery to the appropriate recycling or reuse facility.
4. Hazardous Waste and Hazardous Materials: Handle in accordance with applicable regulations. If encountered, such waste and materials shall be abated under separate contract.

B. The following sorting methods are acceptable:

1. Sorting recyclable materials at the Project site and transporting them to recycling markets directly from the Project site.
2. Employing haulers who make use of a materials-recovery facility or a transfer station where recyclable materials are sorted from the waste and recycled before disposing of the remainder. If using a hauler or recycling facility to sort out recyclables, verify that the hauler sorts out all construction waste loads and is not limited to those that are not acceptable at the landfill. Also, verify that the hauler or recycling facility recycles at least three types of materials.

1.7 WASTE MANAGEMENT PLAN IMPLEMENTATION:

A. The Contractor shall designate a party (or parties) who shall be responsible for instructing construction personnel and overseeing and documenting results of the Construction Waste Management Plan.

B. Distribution: The Contractor shall distribute copies of the Construction Waste Management Plan to the Project Foreman, each Subcontractor, the Owner, and the Architect.

C. Instruction: The Contractor shall provide on-site instruction regarding appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all construction personnel at the appropriate phases of the Project.

D. Separation Facilities: The Contractor shall lay out and identify a specific area on the Project site to facilitate separation of materials for recycling, salvage, reuse, and return. Recycling and waste bin areas shall be kept neat and clean, and clearly marked to avoid contamination of materials. Materials for recycling include concrete, non-fibrous wallboard, paper, clean corrugated cardboard (no pizza boxes), non-treated wood, metals (steel, aluminum and copper), and glass bottles (no windows). Provide separate containers, preferably near the job trailer, with smaller containers located at convenient places throughout the job site. Empty smaller containers into larger containers every night or when full. Cover outdoor containers to keep out rain, snow, and wind-driven debris. Lock containers whenever site is not in use to prevent illegal dumping.

E. Hazardous Waste: Hazardous waste shall be separated, stored, and disposed of according to applicable regulations.

F. Application for Payments: With each Application for Payment, the Contractor shall submit a Summary of Waste generated by the Project. Failure to submit this information shall render the Application for Payment void, thereby delaying the Progress Payment. The Summary of Waste shall contain the following information:
   1. The amount (in tons and/or cubic yards) of material landfilled from the Project, the identity of the landfill, and the related disposal cost. Include corresponding manifests, weight tickets, receipts, and invoices.
   2. For each material recycled from the Project, the amount (in tons and/or cubic yards), the date removed from the Project site, the receiving party, the transportation cost, the amount of any money paid or received for the recycled or salvaged material, and the net total cost or savings of recycling. Include corresponding manifests, weight tickets, receipts, and invoices.

G. Implementing the Plan: The Contractor shall designate a party (or parties) responsible for implementing the Construction Waste Management Plan. This party (or parties) shall explain to Contractor's and Subcontractor's construction personnel, the Plan's goals and methods for achieving those goals.

1.8 SPECIAL PROGRAMS:

A. The Contractor shall be responsible for final implementation of programs involving tax credits, rebates, or similar incentives related to recycling, if applicable to the Project. Revenues or other savings obtained for recycling or returns shall accrue to the Contractor.

B. The Contractor shall be responsible for obtaining information packets related to the special programs prior to commencing Work.

C. The Contractor shall document work methods, recycled materials, etc., as required for the tax credits, rebates, or other savings described above.

END OF SECTION

SECTION 01600: MATERIALS AND EQUIPMENT

1. SCOPE:

   A. Index:

      1. Scope
      2. Materials
      3. Equipment
      4. Hazardous Material Requirements
      5. Material Storage
      6. Protection
      7. Revisions

2. MATERIALS:

   A. Furnish materials of the type, qualities, and characteristics specified. The specification of a trade name and catalog number is intended to establish quality, type, character, and operating characteristics of the material required. Materials by other manufacturers of equal specifications will be accepted, excepting as may be specifically stated otherwise.

   B. Materials shall be delivered adequately protected, in merchantable condition, and in original unbroken packages if normally packaged. They shall be stored and handled so as to protect and maintain their merchantable condition.

   C. The Commissioner of Public Works or his representative shall have the right to reject material not in compliance with the project manual, as well as damaged material, and the contractor shall remove such material from the construction site when and as directed.

3. EQUIPMENT:

   A. Internal combustion engine and compressor shall be equipped with mufflers to reduce noise to a minimum and shall not be operated in enclosed areas without adequate ventilation.

   B. All materials and work procedures used shall be in accordance with all air pollution control regulations in effect at the work site.

4. HAZARDOUS MATERIAL REQUIREMENTS:

   A. The requirements set forth in the OSHA Hazard Communication Standard, 29CFR19101.1200, U.S. Environmental Protection Agency (EPA), and Wisconsin Department of Natural Resources in the Wisconsin Administrative Code NR600, shall be met by each on-site contractor.

      1. Material Safety Data Sheets (M.S.D.S.):

         a. All contractors, which may/may not include the City of Milwaukee, shall provide the M.S.D.S. for all hazardous chemicals to which any person may be exposed at the work site.

         b. A master list will be kept in the office of the Project Supervisor/Construction Manager and updated as materials are delivered.

2. Container Labeling:

a. Each container of hazardous material at the work site shall be clearly labeled with:

(1) Identity of the hazardous chemical(s).

(2) Appropriate hazard warning(s).

(3) Name and address of the manufacturer.

B. The City of Milwaukee reserves the right to stop the work of a contractor if compliance with OSHA regulations is inadequate. Work will not proceed until all applicable safety and health procedures are implemented by the contractor.

5. MATERIAL STORAGE:

A. The storage areas shall be kept in good order and free of all rubbish and debris.

B. Coordinate the delivery and storage of all materials and equipment with the Facilities Development and Management Section Project Inspector.

C. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

D. Store and protect products in accordance with manufacturers' instructions.

E. Store with seals and labels intact and legible.

F. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

G. For exterior storage of fabricated products, place on sloped supports above ground.

H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

I. Prevent contact with material that may cause corrosion, discoloration, or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

6. PROTECTION:

A. The premises and the work shall be adequately protected from damage from the

commencement of work to the date of final acceptance.

B. All construction work and traffic shall remain within the construction area.

C. All damage shall be corrected or repaired by the contractor or contractors causing same at his or their own expense.

D. All open pipes, pipe threads, fittings, and insulation must be protected during construction.

7. REVISIONS:

The right is reserved to make modifications to a reasonable extent as building conditions may require, or as may be required to conform to code rulings, or manufacturer's standards without extra cost to the City.

SECTION 01700: CLEANING AND PROJECT CLOSE-OUT

1. SCOPE:

   A. Index:

   1. Scope
   2. General
   3. Safety Cleaning
   4. Progress Cleaning
   5. Disposal
   6. Final Cleaning
   7. Charges
   8. Record Drawings
   9. Operating Instructions & Maintenance Manuals
   10. Guarantees

2. GENERAL:

   Article 2.5.4 of the General Requirements of City of Milwaukee Department of Public Works shall be supplemented as specified hereinafter.

3. SAFETY CLEANING:

   Safety cleaning: Each contractor is responsible for safety cleaning, which includes but is not limited to the following:

   A. Keep work areas, passageways, ramps, stairs, free of debris and scrap.

   B. Form and scrap lumber shall have nails withdrawn or bent over and lumber shall be stacked or removed.

   C. Remove spills of oil, grease, or other liquids immediately or sprinkle with sand.

   D. Hazardous material shall be handled in accordance with Section 01600. Each container of hazardous material at the work site shall be clearly labeled with:

      a. Identity of the hazardous chemical(s).

      b. Appropriate hazard warning(s).

4. PROGRESS CLEANING:

   A. Prime Contractor and subcontractor shall remove his rubbish and debris from building site promptly upon its accumulation, and prior to the contractor's regular Friday general clean up. Contractor shall perform broom cleaning of all appropriate surfaces each Friday afternoon.

   B. Combustible waste shall be stored in fire resistive containers and disposed of regularly.

   C. Oily, flammable or hazardous wastes such as caustics, acids, harmful dusts, etc., shall be stored in appropriate covered containers.

   D. All solvents and cleaners used on this project must be rated as containing low or no volatile organic compounds (VOC's).

5. DISPOSAL:

A. No burning of rubbish or debris will be allowed at site. No rubbish shall be thrown through opening or from heights without proper protection. Where dust will be generated or flying debris is likely to occur, provide dust tight chutes or other means to control dust.

B. Containers: Contractor shall provide mobile industrial type waste containers in the number and size required, placed at adequate locations to handle debris or provide other methods of disposing of debris.

C. Oil, flammable or hazardous wastes such as, but not limited to, caustics, acids, harmful dusts, etc., shall be placed in properly marked containers as necessary and disposed of at a site designed for such wastes.

6. FINAL CLEANING:

A. Immediately prior to substantial completion.

B. Contractors shall expedite or perform thorough cleaning, sweeping, washing and polishing of work to remove from work and equipment provided under his contract, all foreign matter, spots and soil, so as to put all such work and equipment, including finishes, in a complete and finished condition ready for acceptance and use intended.

C. The contractor is responsible for final sweeping and dusting not covered by other subcontractors. This general cleaning shall include all areas and floors of the building, including the site outside the building.

7. CHARGES:

A. If prime contractors do not remove rubbish or clean building as specified above, owner reserves right to have work done by others at contractor's expense.

B. Employees of the owner who are required to clean up any rubbish or to sweep any floors will record all hours involved to complete such work. The cost incurred by the owner for this special cleaning and sweep-up work shall be charged against the contract price of the contractor as determined by owner.

8. RECORD DRAWINGS:

A. At the completion of work and prior to final payment, the mechanical and electrical contractors shall provide Facilities Development and Management Section with three (3) marked up sets of prints showing all changes or variations from contract drawings, and not specified on change order drawings theretofore issued. Contractors providing buried or concealed piping, conduit, or similar items shall locate such items by dimensions and elevations.

B. Other contractors shall provide one (1) marked up set of prints showing all changes or variations from contract drawings.

C. Drawings shall show complete layout of revised piping, equipment, etc., as actually installed.

9. OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS:

A. The contractor shall, upon completion of all work, furnish the necessary skilled labor to instruct City personnel in the operation, adjustment, and maintenance of all equipment furnished.

B. At termination of work, the contractor shall submit maintenance and operating manuals presenting full details of care and maintenance and operation of mechanical and electrical equipment of every nature. See specific requirements in relevant sections as applicable.

C. The manual shall include manufacturer's instructions for maintenance and operation and shall be completely indexed, including the spare parts list. See specific requirements in relevant sections.

D. Submit three (3) final copies in hard bound cover (and one electronic copy) to FACILITIES DEVELOPMENT AND MANAGEMENT SECTION.

E. Contractor shall provide qualified personnel onsite to provide a minimum of four (4) hours of training to Owner's representatives.

10. GUARANTEES:

A. Each contractor shall guarantee to replace or repair promptly at his own expense, as directed by the Commissioner of Public Works or his agent, all workmanship or materials in which defects may develop within two (2) years from the date of final acceptance of his work. This guarantee includes all damage done to the City due to faulty equipment, poor installation or poor construction.

B. Guarantee periods other than the two year time period are indicated in specific specification sections.

SECTION 01820: TRAINING

1. SCOPE:

A. Index:

1. Scope
2. Training, Operations Instructions, and Maintenance Manuals

2. TRAINING, OPERATIONS INSTRUCTIONS, AND MAINTENANCE MANUALS:

A. This contractor shall, upon completion of the work, instruct City personnel in the operation, adjustment, and maintenance of the HVAC equipment, HVAC controls, fire protection, and life/safety (fire alarms) systems, and lighting controls (by City of Milwaukee).

1. Training for HVAC equipment.

2. Training for HVAC controls.

3. Training for fire protection and life/safety (fire alarms) systems.

4. Training for electrical lighting controls (by City of Milwaukee).

B. Training for HVAC Equipment:

Two levels of on–site training exist for the Downtown Complex Facilities Management staff. In addition to two levels of training, off-site training is appropriate for advanced subjects and particular employees. In total, there are three types of training. The number of training hours varies and is dependent on the scope of the project and complexity of the equipment.

1. On-Site Training:

a. Factory certified trainer to provide training for managers, engineers, mechanics, electricians, and technicians.

b. Service representative to provide operations and maintenance training.

2. Training Hours and Frequency (On-Site Training):

a. Level I:

To be provided upon the completion of the project. Training will be a 1 day minimum. Use of O & M manuals is required. Training is administered in a classroom and field setting (no more than 4 hours at a given session). Reference manufacturer's course offerings for details. This project will require a minimum of 8 hours of training. Level I training is administered to managers, engineers, mechanics, electricians, technicians, and others who interact with HVAC equipment and facilities maintenance.

b. Level II:

Two hour segments, 1 time per hear, 2nd shift only, 2 hours per year (depending in complexity) total. This training serves as both a review and a

systems development preview.

C. Training for HVAC Controls:

Two levels of on-site training exist for the Downtown Complex Facilities Management staff. In addition to the two levels of training, off-site training is appropriate for advanced subjects and particular employees. In total, there are three types of training. The number of training hours varies and is dependent on the scope of the project and complexity of the equipment.

1. On-Site Training:

a. Factory certified trainer to provide training for managers, engineers, mechanics, electricians, technicians, and support staff.

b. Service representative to provide operations and maintenance training.

c. Training for switchboard operators and facility supervisors.

2. Off-Site Training:

a. Off-site training is reserved for complex applications where the factory has a technical training schedule specific to troubleshooting, systems diagnostics, maintenance, and operations. Typically, there will be beginning, intermediate, and advanced level courses offered by the manufacturer. **The course will be selected by the Operations and Maintenance Manager**.

3. Training Hours and Frequency (On-Site Training):

a. Level I:

To be provided upon the completion of the project. Training will be a 1 day minimum. Use of O & M manuals is required. Training is administered in a classroom setting (no more than 4 hours at a given session). Reference manufacturer's course offerings for details. This project will require a minimum of 8 hours of training. Level I training is administered to managers, engineers, mechanics, electricians, technicians, support staff, and others who interact with equipment, hardware, software, and facilities maintenance.

b. Level II:

Two hour segment, 1 time per year, 2nd shift, 2 hours per year total. This training serves as both a review and a systems development preview.

D. Training for Fire protection and Life/Safety (Fire Alarm) Systems:

Two levels of on-site training exist for the Downtown Complex Facilities Management staff. In addition to the two levels of training, off-site training is appropriate for advanced subjects and particular employees. In total, there are three types of training. The number of training hours varies and is dependent on the scope of the project and complexity of the equipment.

1. On-site Training:

a. Factory certified trainer to provide training for managers, engineers, mechanics, electricians, technicians, and support staff.

b. Service representative to provide operations and maintenance training.

c. Training for switchboard operators and facility supervisors.

2. Off-Site Training:

a. Off-site training is reserved for complex applications where the factory has a technical training schedule specific to troubleshooting systems diagnostics, maintenance, and operations. Typically, there will be beginning, intermediate, and advanced level courses offered by the manufacturer. **The Operations and Maintenance Manager will select classes**.

3. Training Hours and Frequency (On-Site Training):

a. Level I:

To be provided upon the completion of the project. Training will be a 2 day minimum. Use of O & M manuals is required. Training is administered in a classroom setting (no more than 4 hours at a given session). Reference manufacturer's course offerings for details. This project will require a minimum of 8 hours training. Level I training is administered to managers, engineers, mechanics, electricians, support staff, and others who interact with equipment, hardware, software, and facilities maintenance.

b. Level II:

Two hour segment 1 time per year, 2nd shift and 3rd shift, 2 hours per year total. This training serves as both a review and a systems development preview.

E. Training for Electrical Lighting Controls (City of Milwaukee):

Provide two levels of on-site training for the Downtown Complex Facilities Management staff and tenants.

1. On-Site Training:

a. Factory certified trainer to provide training for managers, engineers, mechanics, electricians, and technicians.

b. Service representative to provide operations and maintenance training.

2. Training Hours and Frequency:

a. Level I:

To be provided upon the completion of the project. Training will be a 2 hour minimum administered on-site. Level I training is administered to the tenant, managers, engineers, mechanics, electricians, technicians, and others who interact with equipment, hardware, software, and facilities maintenance.

b. Level II:

Two hour segment once per year. This training serves as both a review and a systems development preview.

F. Verification and Validation of Training:

1. An outline of the training and test materials shall be provided to the City's facility O & M Manager two weeks prior to the training sessions. Corrections, additions, and deletions will be at the discretion of the O & M Manager within a week of receiving the test. All written materials, graphs, cue cards, trainer's notes, and phone numbers will accompany the outline for preview.

2. A ½ hour test shall be provided to the City's operations staff. This test shall be given after each of the HVAC equipment, HVAC controls, and fire protection and life/safety (fire alarms) systems Level I on-site training sessions. This test shall include written true and false, essay questions, and hands-on field work performance.

G. Materials:

1. An edited videotape of the training will be provided.

2. All prepackaged videotapes, training software, and textbooks from the manufacturer, specific to the training, will be provided.

H. At the submittal stage, the contractor shall submit maintenance and operating manuals presenting full details of care and maintenance and operation of mechanical and electrical equipment of every nature.

I. The manual shall include manufacturer's instructions for maintenance and operation and shall be completely indexed, including the spare parts list.

J. Submit three (3) final copies in hardbound cover and one (1) electronic copy (pdf) to DPW, ISD - Facilities Development and Management Section.

K. Contractor shall provide to the City a video recording (DVD) of all equipment installed under this contract. Tape shall be provided prior to the installation of any ceilings.

L. Contractor shall video record (DVD) one training session and turn over to the City for future reference.

TECHNICAL SPECIFICATIONS

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SECTION 02225

TRENCH BACKFILL

1.0 PART 1 - GENERAL

1.01 SCOPE

A. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete trenching for utilities and other work, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Submittals
- Record Drawings
- Quality Assurance
- Permits/Fees
- Provisions for Future Work
- Survey and Staking

PART 2 - MATERIALS
- Crushed Stone Bedding
- Crushed Stone Screenings
- Bedding Sand

PART 3 - EXECUTION
- Preparation
- Connections to Existing Utilities
- Dewatering
- Excavation
- Bedding/Initial Cover
- Backfill and Compaction
- Restoration

1.02 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1.03 SUBMITALS

A. Provide copies of record drawings.

B. Provide samples of each type of soil or aggregate proposed for use on the project. Samples shall consist of a minimum of 50 pounds of soil. The contractor shall be responsible for delivering soil samples to the testing agency as designated by the Construction Representative. Provide samples a minimum of 2 weeks prior to starting construction.

C. Provide copies of material testing reports.

1.04 RECORD DRAWINGS

A. Maintain record drawings showing actual locations of utilities and other features encountered, modifications to proposed grades and site features, and other deviations from the original design.

1.05 PERMITS/FEES

A. Contractor shall be solely responsible for obtaining all permits necessary to complete trenching work. The Contractor shall pay all fees associated with obtaining permits. These include, but are not limited to permits to work within right-of-way, utility connection permits, plumbing permits, electrical permits and other building permits.

1.06 SURVEY AND STAKING

A. Contractor shall be responsible for transferring benchmarks, control points, and lines as necessary to complete his work.

2.0 P A R T 2 - P R O D U C T S

2.01 CRUSHED STONE BEDDING

A. Clean material meeting the requirements of "¾" Crushed Stone Chips" as defined in Section 6.43.2(a)2, regardless of pipe size, of Standard Specifications for Sewer and Water Construction.

2.02 CRUSHED STONE SCREENINGS

A. Crushed stone free of organic material, concrete, asphalt and other debris. Material shall meet the requirements of "Crushed Stone Screenings" as defined in Section 6.43.2(b) of Standard Specifications for Sewer and Water Construction.

2.03 BEDDING SAND

A. Sand meeting the requirements of "Bedding Sand" as defined in Section 6.43.2(c) of Standard Specifications for Sewer and Water Construction.

3.0 P A R T 3 - E X E C U T I 0 N

3.01 PREPARATION

A. Review plans and prepare work plan and schedule. Coordinate any necessary interruptions in utility service with Construction Representative, in accordance with other specification sections.

B. Layout work. Establish and transfer line and grade as necessary to complete the work.

C. Remove topsoil from work area. Saw cut and remove pavement from the work area.

3.02 CONNECTIONS TO EXISTING UTILITIES

A. Connect to existing utilities in accordance with the requirements of other pertinent specification sections.

3.03 DEWATERING

A. Dewatering shall be completed as required.

3.04 EXCAVATION

A. Excavate to elevations and dimensions necessary to complete construction. Excavations shall be sufficiently deep to provide for bedding beneath pipes and structures.

B. For pipes less than 12″ in diameter, maximum trench width at the top of the pipe shall be 3′.

C. The trench width at the ground surface shall be minimized to the extent possible through the use of trench boxes, shields, or shoring.

D. The trench width at the ground surface shall not exceed the width of the trench at the top of the pipe by more than 2′ without prior approval by the Construction Representative.

E. Provide a minimum clearance of 6″ from outside of pipe to the closest of either the sidewall of trench or inside wall of trench box, shield or shoring.

F. Notify Construction Representative if trench subgrade consists of unstable soil, organic material, debris or other undesirable material.

G. Segregate the various materials excavated. Reserve material meeting the requirements of backfill for the location. Excavated material that does not meet the requirements of backfill, and excess excavated material, shall be removed from the site and disposed by the contractor, unless directed otherwise by other specification sections or the Construction Representative.

H. Locate bedding, backfill and spoil piles in accordance with OSHA requirements, and so that it does not interfere with public travel, adjacent landowners or other construction activities.

I. Trench excavation shall be limited to that which can be excavated and backfilled within the same workday.

J. The same trench may obstruct no more than one street crossing at one time.

3.05 BEDDING/INITIAL COVER

A. Bed pipes and place initial cover material in accordance with the requirements of specifications for the utility and pipe type being installed.

B. Establish excavation subgrade in accordance with proposed utility lines and grades, allowing for required amount of bedding material.

C. Excavation shall be reasonably free of water prior to placement of bedding material.

D. Place bedding material to required depth, and compact to 95% Modified Proctor dry density.

E. Shape bedding material to conform to bell of pipe, fittings and structures.

F. After placing pipe, support during placement and compaction of initial cover material. Place cover material in lifts having a maximum thickness of 6". Compact initial cover material to 95% Modified Proctor dry density.

G. Compaction of initial cover material for pipe and fittings shall be accomplished using hand tools and vibratory plate or tamping type walk behind compactors.

3.06 BACKFILL AND COMPACTION

A. Once initial cover material is placed and compacted, backfill trenches using the material specified on Table 02310-2, or as shown on the drawings.

B. Backfill trenches to elevations shown on the plans; allow for placement of base course, pavements, and topsoil as required by the plans and other Contract Documents. Where final restoration will be delayed, backfill trench to existing grade to provide a safe, free-draining surface.

C. Moisture condition backfill material as necessary to achieve density required for given use.

D. Do not place material on frozen surfaces or use frozen material.

E. Compact fill material as required by Table 31 23 16.13-2 for the given use.

F. Compact material to minimize settlement and avoid damage to structures, pipes, utility lines and other features. Place backfill simultaneously on both sides of structures.

G. It is the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain the specified density. Vibratory plate or tamping type walk behind compactors will be required whenever backfill is placed adjacent to structures, pipes, utility lines and other features.

H. Flooding or jetting of backfill material for compaction purposes is not allowed.

Location	Required Material	Maximum Compacted Lift Thickness	Minimum Proctor Compaction	Minimum Relative Density (a)
Areas Beneath Footings, Floor Slabs, or Structures	Structural Fill	8"	95% Modified	70%
Footing, Foundation and Structure Backfill	Structural Fill	8"	95% Modified	70%
Areas within 10' of an Existing or Proposed Building or Structure Footing or Slab	Granular Fill	8"	90% Modified	60%
Areas Beneath Existing or Proposed Pavement (Roads,	Granular Fill	8"	90% Modified	60%

Drives, Walks)				
Turf Areas	Earth Fill	12″	85 % Modified	50%

(a) Minimum relative density as determined by ASTM D-4253-00 for coarse-grained soils with less than 15% by mass passing the No. 200 sieve. Applicable only when minimum proctor compaction cannot be achieved.

3.07 RESTORATION

A. Restore trenches to proposed grades and surfaces as soon as practicable after backfilling.

B. Remove excess bedding, backfill and spoil material from the site as soon as possible after backfilling is complete, but no later than 1 calendar dates after backfilling is complete.

C. Thoroughly clean all drainage ways, roads, parking lots sidewalks and paved surfaces and remove and dispose all debris and mud.

D. Patch pavement, asphalt, and curb/gutter to match existing conditions.

END OF SECTION

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SECTION 02510

WATER UTILITY DISTRIBUTION PIPING

1.0 P A R T 1 – G E N E R A L

1.01 SCOPE

A. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide water distribution system components and other work, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Reference Standards
- Submittals
- Quality Assurance
- Permits/Fees
- Survey and Staking
- Record Drawings

PART 2 - MATERIALS
- Ductile Iron Watermain
- Ductile Iron Watermain Fittings
- Valves
- Valve Boxes
- Joint Restraints
- Polyethylene Encasement Bag
- Board Insulation
- Locator Tape
- Chlorine
- Pipe Joint Lubricant

PART 3 - EXECUTION
- General
- Continuity of Existing Water Distribution System
- Connection to Existing Mains/Tapping
- Bedding/Backfilling
- Laying Watermain
- Installing Fittings, Valves and Hydrants
- Joint Restraint
- Filling Watermain
- Pressure Testing
- Continuity Testing
- Disinfection/Flushing
- Bacteriological Sample
- Construction Verification Items

1.02 RELATED WORK

A. Section 02225 – Trench Backfill

1.03 REFERENCE

A. Applicable provisions of Division 1 shall govern all work under this Section.

1.04 REFERENCE STANDARDS

American Society for Testing and Materials (ASTM):

B88	Standard Specifications for Seamlesss Copper Water Tube
F477	Standard Specifications for Elastomeric Gaskets for Joining Plastic Pipe
D3139	Standard Specifications for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
D3350	Standard Specifications for Polyethylene Plastic Pipe and Fittings Materials American Water Works Association (AWWA):
C104/ANSI A21.4-95	Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
C105/ANSI A21.5-99	Standard for Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
C111/ANSI A21.11-00	Standard for Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
C151/ANSI A21.51-02	Standard for Ductile Iron Pipe, Centrifugally Cast for Water or Other Liquids
C153/ANSI A21.53-00	Standard for Ductile Iron Compact Fittings for Water or Other Liquids
C502-94	Dry Barel Fire Hydrants
C504-00	Rubber-Seated Butterfly Valves
C509-01	Resilient-Seated Gate Valves for Water Supply Service
C515-01	Reduced Wall, Resilient Seated Gate Valves for Water Supply Service
C550-01	Protective Epoxy Interior Coatings for Valves and Hydrants
C800-01	Underground Service Line Valves and Fittings
C900-97	Polyvinyl Chloride Pressure Pipe, and Fabricated Fittings for Water Distribution (4”-12”)
C905-97	Polyvinyl Chloride Pressure Pipe, and Fabricated Fittings for Water Distribution (14”-48”)
C906-99	Polyethylene Pressure Pipe, and Fabricated Fittings for Water Distribution (4”-63”)

1.05 SUBMITTALS

A. Provide manufacturers product information (cut sheets) and O&M information for watermain materials including:

1. Pipe
2. Fittings
3. Valves
4. Hydrants

5. Joint Restraint Materials

B. Provide reports that document pressure and continuity testing proceedures and results.

C. Provide reports that document safe sample collection proceedures and results.

D. Provide copies of record drawings.

1.06 QUALITY ASSURANCE

A. Maintain and submit record drawings.

B. Conduct pressure testing, continuity testing and safe sampling as required in Part 3 – Execution.

1.07 PERMITS/FEES

A. Contractor shall be solely responsible for obtaining all permits necessary to complete the work. Contractor shall pay all fees associated with obtaining permits. These include, but are not limited to permits for work within public right-of-way, street opening permits, utility connection permits, and plumbing permits.

1.08 SURVEY AND STAKING

A. Contractor shall be responsible for establishing benchmarks, control points, and lines necessary to complete his work. All utilities and landscaping are approximate. Field verify.

1.09 RECORD DRAWINGS

A. Maintain record drawings that show the actual locations, sizes and types of utilities and other features encountered.

B. Note any modifications to proposed watermain size, alignment, or grades. Record any other deviations from the original design.

2. PART 2 – MATERIALS

2.01 DUCTILE IRON WATERMAIN

A. Centrifugally cast, cement mortar lined ductile iron watermain meeting the requirements of ANSI/AWWA C151/A21.51 and ANSI/AWWA C104/A21.4.

B. Unless otherwise specified, ductile watermain shall be Class 52 as defined by ANSI/AWWA C151/A21.51.

C. Ductile iron watermain joints shall be rubber gasket push-on joint or mechanical joint meeting the requirements of ANSI/AWWA C111/A21.11.

D. Pipe shall be provided with conductive bonding straps to provide electrical continuity.

E. Pipe shall be manufactured in the United States.

2.02 DUCTILE IRON WATERMAIN FITTINGS

A. Cement mortar lined mechanical joint fittings. Fittings shall be compact style fittings meeting the requirements of ANSI/AWWA C153/A21.53.

B. Fittings shall be manufactured in the United States.

2.03 VALVES

A. Resilient seated wedge gate valve meeting the requirements of AWWA C509 and C515. Body, bonnet and gate shall be constructed of ductile iron. Bolts shall be stainless steel.

1. Interior and exterior surfaces of valve shall be provided with epoxy coating meeting the requirements of AWWA C550. Symetrical wedge shall be completely incapsulated with resilient material.
2. Valve stem shall be non-rising bronze. Stem collar shall be provided with thrust bearings both above and below, that are protected by upper and lower O-ring seals.
3. Valve shall be left opening and be provided with standard 2" square operating nut.
4. Valve shall be provided with mechanical joint connections.
5. Mueller, Kennedy, US Pipe, American Flow Control, Clow, or approved equal.

B. Rubber-seated butterfly valve meeting the requirements of AWWA C504, for Class 150B. Body and disc shall be constructed of ductile iron. Bolts shall be stainless steel. Disc shall be lens shaped.

1. Interior and exterior surfaces of valve shall be provided with epoxy coating meeting the requirements of AWWA C550. Disc shall be provided with a stainless steel disc edge.
2. Valve stem shall be stainless steel. Packing shall be permanent duty "chevron V-type" or "O-ring" type. Bearings shall be permanent, non-metallic, and self-lubricating.
3. Valve seat shall be a single piece of elastomeric material that is not penetrated by the valve shaft.
4. Provide manual operator that is suitable for underground service and includes a standard 2" square operating nut.
5. Valve shall be provided with mechanical joint connections.
6. Mueller/Henry Pratt, Kennedy or approved equal.

C. Tapping Valve: Resilient seated wedge gate tapping valve having 100% port, and meeting the requirements of AWWA C509 and C515. Body, bonnet and gate shall be constructed of ductile iron. Bolts shall be stainless steel.

1. Interior and exterior surfaces of valve shall be provided with epoxy coating meeting the requirements of AWWA C550. Symetrical wedge shall be completely incapsulated with resilient material.

2. Valve stem shall be non-rising bronze. Stem collar shall be provided with thrust bearings both above and below, that are protected by upper and lower O-ring seals.
3. Valve shall be left opening and be provided with standard 2″ square operating nut.
4. Valve shall be provided with flange connection on inlet side of valve and mechanical joint connections on outlet side of valve.
5. Provide suitable companion tapping sleeve.
6. Mueller, US Pipe, American Flow Control, Clow, or approved equal.

2.04 VALVE BOXES

A. Curb Stop Boxes

1. Curb stop boxes shall be 1 1/4″ minimum diameter, cast iron, arch style, valve boxes. Boxes shall be telescopic, extendable to accommodate 7′ bury. Lid shall be two piece threaded, with a plug having a pentagonal bolt for removal.

2. Provide valve box extensions as necessary to accommodate depth of cover shown on plans, or 6.5′ minimum.

3. Ford, Mueller, or approved equal.

2.05 JOINT RESTRAINTS

A. Retainer Glands for Ductile Iron Pipe

1. Wedge action retainer glands designed for use with ductile iron pipe.

2. Glands shall be constructed of ductile iron. Restraint shall be provided by a minimum of three wedges which are tightened onto the exterior of the pipe using a threaded, torque limiting mechanism.

3. Glands shall be tested to provide restraint at 250 psi operating pressure.

4. Retainer glands shal be MEGA-LUG by EBBA Iron, or approved equal.

B. Watermain Clamps

1. Steel clamps specifically fabricated for use in pipe restaint systems. Watermain clamps shall be selected based on size of the main.

2. Watermain clamps shall be conducted of flat steel stock, ½″ thick x 2″ wide minimum dimensions.

3. Astral, or approved equal

C. Watermain Clamp Hardware

1. Corrosion resistant steel hardwater specifically fabricated for use in pipe restraint systems.

2. Astral, or approved equal.

D. Threaded Rod for Joint Restraint

1. ¾ " diameter, threaded rod. Rod shall be constructed of carbon steel having a minimum tensile strength of 30 ksi. Rod shall be zinc plated.

2.06 POLYETHYLENE ENCASEMENT BAG

A. 8-mil polyethylene encasement bag meeting the requirements of ANSI/AWWA C105/A21.5.

2.07 BOARD INSULATION

A. Rigid, closed-cell, extruded polystyrene insulation. Insulation shall be suitable for buried installation.

B. Individual boards shall have minimum dimensions of 8'x4'x2".

C. Dow Styrofoam, or approved equal.

2.08 LOCATOR TAPE

A. Detectable metallic locator tape, specifically manufactured for marking utilities.

B. Tape shall be a minimum of 6" wide and designed to be detectable at a depth of 18".

C. Tape shall be marked "WATER" and blue colored.

2.09 CHLORINE

A. Calcium hypochlorite tablets or granuels. Calcium hypochlorite product shall meet all applicable AWWA and NSF standards for use as a watermain disinfectant.

B. Arch "HTH", or approved equal.

2.10 PIPE JOINT LUBRICANT

A. Petroleum free pipe lubricant formulated for use with potable water systems. Product shall meet the requirements of ANSI/NSF Standard #61.

3.0 PART 3 – EXECUTI0N

3.01 GENERAL

A. Complete exploratory excavations at utility crossings as shown on the plans and as necessary to complete the work.

B. Maintain clearances between watermains and existing or proposed sewer lines as follows:

1. 8′ horizontal separation (measured center to center) between watermains and existing or proposed sanitary or storm sewers.
2. 6″ vertical separation (measured from outsides of pipes) where watermains cross over sanitary or storm sewers.
3. 18′ vertical separation (measured from outsides of pipes) where watermains cross under sanitary or storm sewers.

C. Notify the Engineer of utility conflicts as soon as they are encountered.

D. Store and handle pipe in accordance with manufacturers recommendations. Keep pipes clean of soil, debris and animals.

3.02 CONTINUITY OF EXISTING WATER DISTRIBUTION SYSTEM

A. Provide a construction schedule to MPD Construction Representative, municipal water utility and local fire department for review and approval prior to starting construction. Schedule shall indicate the date and time of all required water supply interruptions.

B. Do not interrupt existing water supply without approval from MPD Construction Represenative, municipal water utility, and local fire department.

C. Once approved, notify all distribution system users impacted by outages a minimum of 48 hours in advance of outage. Notification shall be provided in writing and describe the nature and duration of outages, and provide the name and number of Contractor's foreman or other contact.

D. Watermain construction shall be completed in a manner that minimizes interruptions to existing services.

3.03 CONNECTIONS TO EXISTING WATERMAINS/TAPPING

A. Connect to existing watermains at the locations shown on the plans. Unless otherwise shown on the plans, connections shall be made by "live tapping" the main. Contractor shall provide all materials and labor required to complete the "live tap".

B. Provide tapping sleeves, valves, cutting-in sleeves and other materials specifically manufactured for use with the type of pipe to which the connection is being made.

C. Whenever possible, connections shall be made at existing pipe stubs, valves or other fittings.

D. When connecting to existing mains, locate the proposed valve as close to the existing main as possible. Swab the interior surfaces of all pipe, fittings, valves that will be exposed to the existing system. Swab solution shall consist of a 5% (by weight) solution of calcium hypochlorite.

3.04 BEDDING AND INITIAL COVER

A. Provide bedding and initial cover in accordance with the applicable requirements of Section 31 23 16.13 – Trenching.

B. Watermain and water service piping shall be provided with 4″ of bedding material and 12″ of initial cover material (both measured at the bell of the pipe).

C. Bedding and cover material for various types of pipe shall consist of the following:

1. Ductile Iron Watermain: Bedding sand or crushed stone screenings.

3.05 LAYING WATERMAIN

A. Install watermain at locations and depths shown on the plans.

B. Provide a minimum of 6.5′ of cover over watermain, unless otherwise shown on the drawings or directed by the Construction representative. For watermains with less than 6.5′ of cover, provide insulation as shown on the drawings, or as directed by the Construction Representative.

C. Check watermain grades regularly using rotating level or other accurate method. Lay watermain at uniform grades between deflection points shown on the plans; do not install watermains with intermediate high points.

D. Unless otherwise shown or approved by the Construction Representative, lay pipe with bell end facing the direction of pipe laying.

E. For ductile iron watermain, place polyethylene encasement bag on watermain prior to lowering into trench. Once pipe is joined, pull bag over entire length of pipe, overlap joint at adjacent pipe and secure using "Duct" tape or other approved method.

F. Prepare pipe bell and gasket in accordance with manufacturers requirements. Lubricate bell and/or pipe with AWWA/NSF approved lubricant.

G. Push pipe home in accordance with manufacturer's recommendations regarding tools and methods.

H. Pipe joint deflection shall not exceed manufacturer's requirements.

I. For ductile iron pipe, connect bonding straps or lugs to provide electrical continuity along entire watermain. Provide exothermic weld to attach new bonding straps, when existing straps are missing or damaged. Follow manufacturer's requirements for exothermic welding proceedures.

J. Disinfect pipe by placing calcium hypochlorite in each section of pipe as pipelaying progresses. Provide dosage as indicated on Table 02530-1.

Watermain Nominal Diameter (inches)	Dose Calcium Hypochlorite* (oz/length pipe)
8	3

* Granular/tablet calcium hypochlorite with 68% (weight) available chlorine
Table 02530-1

K. Provide insulation 2″ thick x 4′-0″ wide installation over top of new ductile iron water main.

L. Install insulation on compacted initial cover material 6" above the top of pipe. Stagger joints when placing multiple layers of insulation.

M. Provide insulation with a minimum of 1' of initial cover material. Place backfill material in manner that does not damage insulation; replace damaged insulation.

N. Mark the location of dead-end mains with an 8' long 4x4 timber and steel "U" fence post.

3.06 INSTALLING FITTINGS, VALVES

A. Install fittings valves at locations shown on the drawings.

B. Unless otherwise shown, provide mechanical joint connections. Install materials in accordance with manufacturer's recommendations.

C. Maintain electircal continuity through all fittings and valves. Provide and install suitable jumper cables for epoxy coated valves.

D. Place valves on 4"x8"x16" solid concrete masonry units set on compacted soil.

E. Install joint restraints in accordance with the requirements of this section.

F. Install valve box so that bonnet rests on compacted initial backfill material at the same elevation as the top of the valve stuffing box. Center the valve box over the valve nut.

G. Install valve box plumb and level, backfilling evenly. Extend valve box to proposed final grade; provide valve box extensions as necessary. Valve boxes that shift during backfilling or restoration shall be excavated and re-set.

H. Mark all valve boxes with a steel "U" fence post to protect them from damage.

3.07 JOINT RESTRAINT

A. Unless otherwise noted, all fittings (bends, tees, crosses, caps, etc.), valves and hydrants shall be installed with restrained joints. Additionally, branch runs of pipe shall be installed with restrained joints beginning at the fitting at the main to the first valve.

B. Hydrant leads shall be provide with restrained joints beginning at the fitting at the main to the hydrant.

C. Joint restraint shall be provided using retainer glands.

D. If approved by the City of Milwaukee, watermain clamps and threaded rod may be used as an alternative means of joint restraint.

E. Install all joint restraint products in accordance with manufacturer's recommendations and drawings.

F. If approvde for use, watermain clamps, threaded rod and associated hardware shall be fully encased in polyethylene encasement bag.

3.08 FILLLING WATERMAIN

A. Fill watermain after main has been installed and completely backfilled.

B. Fill main slowly to limit entrapped air and evenly distribute calcium hypochlorite. Open all hydrants completely to allow air to escape and monitor filling.

C. Once main is full, allow a minimum of 48 hours time for disinfection to occur before flushing.

3.09 PRESSURE TESTING

A. Pressure test all watermain and water services.

B. Provide all valves fittings, joint restraints, hoses, compressors, and water and power supply as necessary to complete pressure testing. Utilize testing apparatus that is fabricated specifically for testing watermains. Calibrate pressure gauges as necessary.

C. Flush main as necessary to remove air prior to testing. Comply with the requirements of this section with respect to flushing.

D. For longer installations or installations consisting of watermain and copper water service, the Contractor may elect to pressure test the system in short segments.

E. All pressure testing shall be conducted in the presence of the Construction Representative. Provide minimum of 48 hours advanced notice of testing.

F. Conduct a combined pressure/leakage test for 1 hour at a pressure equal to 150% of system normal operating pressure (as measured at the lowest point in the system), or a minimum pressure of 150 psig.

G. When conducting test, pressure test equipment shall be set-up as close to the highest point in the line as possible.

H. Make-up water for the test shall be clean potable water suplemented with ½ oz of dry calcium hypochlorite per 35 gallons of water.

I. Leakage for test shall not exceed gallons per hour as allowed by the attached formula:

$$G = (ND\sqrt{P})/7400$$

Where: G= Allowable leakage (gallons per hour of test)
N=Number of joints under test
D=Nominal diameter of main (inches)
P=Average pressure during test (psig)

J. Record and document pressure test by recording the following information:

1. Date of test
2. Section tested
3. Diameter and length of main under test
4. Number of fittings, valves hydrants, etc.
5. Results of test including test length, pressure, actual water loss
6. Calculation of allowable leakage

7. If a failed test, describe actions taken to eliminate leaks and results of re-testing

K. Submit reports documenting pressure testing.

L In addition to the above referenced testing, complete hydrostatic testing and main flushing per NFPA 13 Chapter 10. Submit Material and Test Certificate for Underground Piping to A/E.

3.10 CONTINUITY TESTING

A. At the request of the Construction Representative, conduct continuity test on all ductile iron watermain and copper water services.

B. The continuity test shall be performed using an multi-meter to verify electrical continuity of the watermain system.

C. The Contractor shall furnish all labor and equipment necessary to conduct the continuity test.

D. Document continuity testing by recording the following information:

1. Date of test
2. Test methods and equipment
3. Section tested
4. Diameter and length of main under test
5. Number of fittings, valves hydrants, etc.
6. Results of test including resistance
7. If a failed test, describe actions taken to eliminate leaks and results of re-testing

E. Submit reports documenting continuity testing.

3.11 DISINFECTION/FLUSHING

A. After filling the main, allow a minimum of 48 hours time for disinfection to occur before flushing.

B. Flush all sections of watermain and water service. When possible, utilize hydrants or other large diameter orifices to complete flushing and achieve 2.5 fps water velocity. If needed, utilize services or temporary connections to complete flushing.

C. All watermain and services shall be flushed for a minimum of 10 minutes, or as necessary to obtain a sediment-free and bacteriologically safe sample.

D. Utilize diffusers, hoses, settling basins and other devices as necessary to limit erosion and other damage to the site and downstream areas.

E. Contractor shall be responsible for providing all necessary fitting, valves, joint restraints, hydrants and other materials necessary to conduct flushing.

F. Submit reports documenting disinfection and flushing.

3.12 BACTERIOLOGICAL SAMPLE

A. Following all pressure testing and flushing, the contractor shall collect a sample from the newly installed watermain or water service(s). Samples shall be submitted to the State Laboratory of Hygiene, or other licensed testing laboratory for bacteriological (colliform bacteria) analysis.

B. The Contractor shall be responsible for all costs associated with sample collection(s) and analysis.

C. Document bacteriological sample collection and analysis by recording the following information:

1. Date of sample collection
2. Sample collection methods and equipment
3. Person collecting the sample
4. Location(s) sample was collected
5. Results of sample analysis

D. If sample results indicate water is "Unsafe – Colliform Bacteria Present", Contractor shall re-disinfect watemain and water services by introducing additional chlorine into the line and re-flushing the main. This process shall be repeated as necessary until a clean sample is obtained. The Contractor shall be responsible for all costs associated with all efforts necessary to obtain a "Safe – Coliform Bacteria Not Present" sample.

E. Submit reports documenting bacteriological sample collection and analysis.

END OF SECTION

SECTION 02920

SOIL PREPARATION

1.0 P A R T 1 – G E N E R A L

1.01 SCOPE

A. The work under this section shall consist of providing all work, materials, labor, equipment and supervision necessary to provide and prepare soil for seeding, sodding, and landscape planting. Included are the following topics:

PART 1 - GENERAL
- Scope
- References
- Submittals

PART 2 - MATERIALS
- Topsoil
- Organic Soil Amendments
- Fertilizer

PART 3 - EXECUTION
- Subgrade Soil Preparation
- Placing Topsoil
- Organic Soil Amendments and pH Adjustment
- Fertilizer

1.02 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1.03 REFERENCE STANDARDS

A. WISDOT SSHSC: Standard Specifications for Highway and Structure Construction
B. Section 625.2: Standard Specifications for Highway and Structure Construction
C. Section 629.3.1: Standard Specifications for Highway and Structure Construction
D. ASTM D5268-07: Standard Specification for Topsoil Used for Landscaping
E. USDA Agricultural Handbook No. 60: Diagnosis and Improvement of Saline and Alkali Soils

1.04 SUBMITTALS

A. Provide product data, including applicable analytical data, for soil amendments including:

a. Peat products
b. Fertilizer

B. Provide copies of all quality assurance testing reports.

2.0 P A R T 2 – P R O D U C T S

2.01 TOPSOIL

A. Clean salvaged or imported material capable of passing the 1″ sieve and meeting the requirements of Section 625.2(1) of the Standard Specifications for Highway Construction. The material shall be free of rocks, gravel, wood, debris, and of noxious weeds and their seeds.

2.02 ORGANIC SOIL AMENDMENTS

A. Organic soil amendments acceptable as part of a backfill mix include:

1. Peat Moss - Type 1 sphagnum, weed and seed free, 3.1-5.0 pH
2. Sedge Peat - decomposed peat with no identifiable fibers
3. Leaf Compost - screened and free of trash and other debris
4. Compost - standard commercial grade compost of sheep or cow manure
5. Composted Sewage Sludge - approved, screened, polymer-dewatered sewage sludge, 6.2-7.2 pH
6. Pine Bark - potting grade pine bark with no particles larger than 1/2" (1.3 cm), less than 10% wood fiber

B. Organic soil amendments shall be capable of passing the 1" sieve. The material shall be free of rocks, gravel, wood, debris, and of noxious weeds and their seeds.

2.03 FERTILIZER

A. Use commercially available fertilizer meeting the requirements of Section 629.2.1.1 of the Standard Specifications for Highway Construction. Unless otherwise specified or shown on the Drawings, provide Type "A" fertilizer.

B. All fertilizers shall be delivered fully labeled according to applicable regulations, bearing name, trade name or trademark of producer, along with producer's warranty. Application amounts of fertilizer and lime will be governed by the recommendations of the soil test.

3.0 P A R T 3 – E X E C U T I O N

3.01 SUBGRADE SOIL PREPARATION

A. Remove or mow all vegetation to a height 3". Remove all rocks, debris, and litter that will prevent compliance with topsoil and seeding specifications. Final grade area to within 2" of subgrade elevations. Till or disc the subsoil to a depth of 2"-4" to allow aeration.

3.02 PLACING TOPSOIL

A. Place topsoil to achieve final grades indicated on the Drawings, allowing for settlement. Place topsoil to the depth shown on the Drawings. If no depth is shown provide a minimum of 4" of topsoil.

B. Do not apply topsoil to saturated or frozen subgrades.

3.03 FERTILIZER

A. Fertilizer shall be applied in accordance with the requirements of Section 629.3.1 of the Standard Specifications for Highway Construction.

END OF SECTION

SECTION 02950

SODDING

1.0 PART 1 - GENERAL

1.01 SCOPE

A. Work includes sodding and maintenance. Furnish all labor, material and equipment necessary to perform the sodding and related work as indicated on the drawings.

PART 1 – GENERAL
- Scope
- Related Work
- Delivery, Storage and Handling
- Planting Conditions
- Guarantee

PART 2 – PRODUCTS
- Sod
- Fertilizer
- Water

PART 3 – EXECUTION
- Preparation
- Sodding
- Fertilizing
- Cleaning
- Completion and Repair
- Inspection
- Maintenance

1.02 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1. 02920 - Soil Preparation

1.03 DELIVERY, STORAGE AND HANDLING

A. Protect sod from sun, wind and dehydration during transport to site.

B. Deliver fertilizer to the site in original, sealed containers, and store in a waterproof space.

C. Place Provide the manufacturer's name, analysis, trademark and guarantee as per standards of the Wisconsin Department of Agriculture on the containers.

1.04 PLANTING CONDITIONS

A. Do not Install sod when the air temperature is above 95ºF (35ºC).

1.05 GUARANTEE

A. Guarantee in writing that the sod be properly approved and/or certified, uniform in appearance and quality, and free of visible imperfections prior to and after installation.

2.0 P A R T 2 - P R O D U C T S

2.01 SOD

A. Provide Highland type, nursery-grown sod of dense growth, with a strong, fibrous root system, and shall be composed of at least seventy-five (75) percent Kentucky Bluegrass, mixed with fescue and perennial rye grasses, and free of pernicious

weeds. Cut the sod at a length of approximately 2" (5.1 cm), and rake the sod free of debris.

B. Install standard sections of sod of enough strength to support their own weight and to retain their size and shape when held within its upper ten (10) percent and suspended vertically.

2.02 FERTILIZER

A. Use a granular, non-burning product composed of not less than fifty (50) percent organic slow-acting, guaranteed analysis professional fertilizer. Fertilizer shall conform to Wisconsin State Statutes, Section 94.64.

B. Commercially available type 'B' top-dressing fertilizer shall be composed of 20% nitrogen, 5% phosphoric acid, and 20% potash, unless directed otherwise by prior soil test.

2.03 WATER

A. Maintain adequate water supplies suitable for irrigation and free of harmful materials.

3.0 PART 3 - EXECUTION

3.01 PREPARATION

A. Loosen the soil surface by equipment or hand methods to a reasonably fine granular texture, and to a depth of not less than 1". The surface shall be lightly and uniformly watered to the loosened depth prior to installation.

B. Apply commercial fertilizer at a rate of 1 lb. per 1,000 sq. ft., and lightly rake into the soil.

3.02 SODDING

A. Install sod at the finish grade(s) specified on a surface prepared and finished to an even, loose and uniform surface.

B. Harvest, deliver, cut, and lay sod within a 24-hour period. Harvested sod not installed within this time period may still be used if examined and approved by Owner prior to installation.

C. Machine-cut sod at a uniform ¾" soil thickness plus or minus 1/4" (excluding top growth and thatch). Cut the sod in uniform commercial-sized strips, with no partial strip smaller than 18" x 24". Broken pads and torn or uneven ends are unacceptable, as is sod harvested by the supplier under drought conditions.

D. Lay sod with the first row in a straight line, and with subsequent rows placed parallel to the first and tight against one another. Stagger lateral joints. The overlapping of sections and spaces between joints are both unacceptable. Sod sections are not to be stretched.

E. On slopes greater than 1:4, install sod perpendicular to the slope, with staggered joints, and secure with wooden stakes of 6" minimum length, driven plumb to the soil portion of the sod, and spaced along the longitudinal length of the sod strip, between 18" and 36" apart. Once sod is rooted, remove or drive stakes into ground.

F. Immediately roll newly sodded sections to remove minor depressions and irregularities, and to eliminate air pockets. The roller is to weigh no more than 150 lbs. per linear foot of roller width.

G. Lightly water newly sodded sections during installation. Following rolling, water sections thoroughly enough to dampen the subsoil to a depth of 4". Moderately water sodded areas daily, without allowing the subsoil to be waterlogged, until Owner acceptance.

3.03 FERTILIZING

A. Perform all chemical applications in accordance with current federal, state and local laws, through EPA-registered materials and application techniques, and performed under the supervision of a licensed certified applicator.

B. Apply type 'B' fertilizer with a mechanical rotary or drop-type distributor approximately thirty (30) days after sodding, at a rate equal to 1 lb. per 1,000 sq. ft., and thoroughly water into the soil.

3.04 CLEANING

A. Promptly remove waste and excess material from the seeding operation. Clean adjacent paved areas, and repair any damage to existing adjacent turf areas.

3.05 COMPLETION & REPAIR

A. Perform all necessary weeding, mowing and trimming, and shall replace any section larger than 1 sq. ft. (0.09 sq. m.) that is bare or otherwise damaged. Mow grass to a height of 2-1/2" at least twice prior to acceptance.

3.06 INSPECTION

A. Submit a written request to the Owner at least five (5) working days prior to the desired date for an inspection all areas of installed sod at the conclusion of the contracted maintenance period.. Owner will note the condition of the sodded areas, including any instances of settlement, washouts, tire damage, and etcetera and determine whether the maintenance period shall be extended. Owner will notify the Contractor in writing of acceptance.

3.07 MAINTENANCE

A. Fertilizing: Fertilize sodded areas in early spring at a rate equivalent to 1/2 lb. per 1,000 sq.ft. (0.24 kg/100 sq. m.).

B. Watering: Water sodded areas thoroughly every 2 to 3 days, as required in the absence of rain.

C. Mowing: Mow cool season grasses, such as bluegrass, tall fescue, perennial ryegrass, and etcetera to a height of 2-1/2" in spring and fall, and no less than 3" from June through September. Maintain heights through repeat mowings as needed during the length of the contract.

D. Remove no more than forty (40) percent of grass leaf during any single mowing operation.

E. Include trimming around obstacles and the raking of excess grass clippings in the mowing operation.

END OF SECTION

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SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete for the following:

1. Slab on grade

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 305 - Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 308.1 - Standard Specification for Curing Concrete.
5. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
4. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
5. ASTM C150 - Standard Specification for Portland Cement.
6. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
7. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
8. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
9. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
10. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
11. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
12. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
13. ASTM C685/C685M - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
14. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
15. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
16. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

17. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
18. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
19. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
20. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
21. ASTM C1218/C1218M - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
22. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
23. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
24. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
25. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.3 PERFORMANCE REQUIREMENTS

A. Vapor Retarder Permeance: Maximum 0.1 perms when tested in accordance with ASTM E96/E96M, desiccant method water method.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on joint devices, attachment accessories, admixtures and.

C. Design Data:

1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:

   a. Hot and cold weather concrete work.
   b. Air entrained concrete work.

2. Identify mix ingredients and proportions, including admixtures.
3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

D. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301 ACI 318.

B. Conform to ACI 305 when concreting during hot weather.

C. Conform to ACI 306.1 when concreting during cold weather.

D. Acquire cement and aggregate from one source for Work.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01600 - Product Requirements: Environmental conditions affecting products on site.

B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.

1.7 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal Portland type.

B. Normal Weight Aggregates: ASTM C33

1. Coarse Aggregate Maximum Size: In accordance with ACI 318.

Water: ACI 318; potable, without deleterious amounts of chloride ions

2.2 ADMIXTURES

C. Air Entrainment: ASTM C260.

D. Chemical: ASTM C494/C494M.

1. Type A - Water Reducing.
2. Type B - Retarding.
3. Type C - Accelerating.
4. Type D - Water Reducing and Retarding.
5. Type E - Water Reducing and Accelerating.
6. Type F - Water Reducing, High Range.
7. Type G - Water Reducing, High Range and Retarding.

E. Fly Ash ASTM C618 Class C.

F. Slag: ASTM C989; Grade 80 100 120; ground granulated blast furnace slag.

G. Plasticizing: ASTM C1017/C1017M Type I, plasticizing Type II, plasticizing and retarding.

2.3 REINFORCEMENT MATERIALS

A. Welded Plain Wire Fabric: ASTM A185/A185M; in flat sheets; unfinished, 6 x 6 welded wire mesh. Set wire fabric min 1" to bottom of slab.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for support of reinforcing; plastic tipped or non-corroding for supports in slabs forming or where supports are exposed to weather.

C. Fabricate concrete reinforcement in accordance with ACI 301 and ACI 318.

2.2 CONCRETE MIX

A. Select proportions for concrete in accordance with ACI 318 trial mixtures or field experience or both.

B. Provide concrete to the following criteria:

Slab on Grade	
Material and Property	**Measurement**
Compressive Strength (28 day)	4000 psi
Cement Type	ASTM C150
Cement Content (minimum)	470 pounds/cu yd
Aggregate Type	Normal weight
Aggregate Size (minimum)	1 1/2 inch
Air Content	None
Fly AshAlone	If fly ash is used alone, limit the maximum replacement to 25%.
GGBFS (Ground Granulated Blast Furnace Slag) and Fly Ash Content	50% total replacement of Portland cement with GGBFS and fly ash at a 1:1 ratio up to 350 pounds with a maximum 25% fly

C. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer.

1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
2. Do not use calcium chloride nor admixtures containing calcium chloride.
3. Use set retarding admixtures during hot weather.
4. Add air entrainment admixture to concrete mix for work exposed to freezing and thawing or deicing chemicals.

D. Average Compressive Strength Reduction: Permitted in accordance with ACI 318 Ready Mixed Concrete: Mix and deliver concrete in accordance with ASTM C94/C94M Site Mixed Concrete: Mix concrete in accordance with ACI 318.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.

B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

C. Remove debris and ice from formwork, reinforcement, and concrete substrates.

D. Concrete surfaces shall be free of stains, groups, and other visible unacceptable marks.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 301 and ACI 318.

B. Notify testing laboratory and Architect/Engineer minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, are not disturbed during concrete placement.

D. Deposit concrete at final position. Prevent segregation of mix.

E. Place concrete in continuous operation for each panel or section determined by predetermined joints.

F. Consolidate concrete.

G. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

H. Place concrete continuously between predetermined expansion, control, and construction joints.

I. Do not interrupt successive placement; do not permit cold joints to occur.

J. Place floor slabs in checkerboard or saw cut pattern indicated.

K. Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.

L. Screed slabs on grade level, maintaining surface flatness of F_f of 20 maximum 1/4 inch in 10 ft.

3.4 CONCRETE FINISHING

A. Provide formed concrete surfaces to be left exposed with smooth rubbed.

B. Finish concrete floor surfaces in accordance with ACI 301and ACI 318.

C. Steel trowel surfaces which are indicated to be exposed.

3.5 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

1. Protect concrete footings from freezing for minimum 5 days.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Cure floor surfaces in accordance with ACI 301 and ACI 318.

D. Ponding: Maintain 100 percent coverage of water over floor slab areas continuously for 7 days.

E. Spraying: Spray water over floor slab areas and maintain wet for 7 days.

3.6 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements 01700 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform field inspection and testing in accordance with ACI 318 Provide free access to Work and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete for review prior to commencement of Work.

D. Concrete Inspections:

1. Continuous Placement Inspection: Inspect for proper installation procedures.
2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.

E. Strength Test Samples:

1. Sampling Procedures: ASTM C172.

2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, field cured.
3. Sample concrete and make one set of three cylinders for every 150 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area for slabs and walls.
4. When volume of concrete for any class of concrete would provide less than 5 sets of cylinders, take samples from five randomly selected batches, or from every batch when less than 5 batches are used.
5. Make one additional cylinder during cold weather concreting, and field cure.

F. Field Testing:

1. Slump Test Method: ASTM C143/C143M.
2. Air Content Test Method: ASTM C173/C173M
3. Temperature Test Method: ASTM C1064/C1064M.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

G. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39/C39M.
2. Test Acceptance: In accordance with ACI 318.
3. Test one cylinder at 7days.
4. Test two cylinders at 28 days.
5. Retain one cylinder for 56 days for testing when requested by Architect/Engineer.
6. Dispose remaining cylinders when testing is not required.

H. Core Compressive Strength Testing:

1. Sampling and Testing Procedures: ASTM C42/C42M.
2. Test Acceptance: In accordance with ACI 318.
3. Drill three cores for each failed strength test from concrete represented by failed strength test.

I. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.7 PATCHING

A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.

C. Patch imperfections as directed by Architect/Engineer in accordance with ACI 301 and ACI 318.

3.8 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by Architect/Engineer.

END OF SECTION

SECTION 04200
UNIT MASONRY

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section includes all labor, supervision, material, equipment and related services necessary to furnish and install:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Miscellaneous masonry accessories.
7. Grouting of frames.

1.2 RELATED WORK

A. Applicable provisions of Division 1 shall govern all work under this Section. The Contractor shall consult these provisions in detail prior to proceeding with work.

1. Division 08 "Hollow metal Doors and Frames" for hollow metal frames to be anchored into masonry walls and grouted solid.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

A. Provide enclosure to confine dust, dirt and debris to work area.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

1. Concrete masonry units to have 2 hour fire resistive rating unless noted otherwise.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. CMUs: ASTM C 90.

1. Density Classification: Normal weight.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

2.3 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

B. Concrete Lintels: ASTM C 1623, matching CMUs density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color to match existing mortar color.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Capital Materials Corporation; Flamingo Color Masonry Cement.
b. Cemex S.A.B. de C.V
c. Essroc, Italcementi Group

d. Holcim (US) Inc.
e. Lafarge North America Inc.
f. Lehigh Cement Company
g. National Cement Company, Inc.; Coosa Masonry Cement.

E. Aggregate for Grout: ASTM C 404.

F. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M. Electrically welded and galvanized side and cross rod truss type.. Conform with IBC 2009 Section 2103.13. Galvanizing shall conform to ASTM A 116, class 1 (min. 4 oz. per square foot).

1. Single Wythe Walls:Truss type with deformed No. 9 gage side wires and plain cross rods. Provide specially fabricated units for all corners and all wall intersections.

a. Products:

1) Wire Bond Truss 2 Wire System Series 300.
2) Hohman & Barnard, Inc Truss Mesh No. 120.

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
2. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.
3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.

B. Corrugated Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from steel sheet, galvanized after fabrication not less 0.043 inch thick.

C. Partition Top anchors: 0.25" bent plate or angles. Fabricate from steel, hot-dip galvanized after fabrication.

2.7 MASONRY CLEANERS

A. Proprietary Non-Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.8 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For reinforced masonry, use portland cement-lime mortar.
4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
1. For reinforced masonry, use Type S.
2. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.

4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Non Load bearing Partitions

1. Install compressible filler in joint between top of non-load bearing partition and underside of structure above.
2. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 46 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings or edge of infill and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Rake out mortar joints where intended for sealants.

3.8 LINTELS

A. Provide concrete or masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.9 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.10 REPAIRING, POINTING, AND CLEANING

A. Where new work occurs, remove and/or replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that prevent proper installation of adjacent materials. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.11 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove these and all waste materials from Project site.

END OF SECTION 04200

SECTION 07844
FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section includes all labor, material, equipment, supervision and related services necessary to installing fire-resistive joint systems in joints in or between fire-resistance-rated constructions.

1.2 RELATED WORK

A. Applicable provisions of Division 1 shall govern work under this Section. The Contractor shall consult these provisions in detail prior to proceeding with work.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

C. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:

1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:

a. Fire-resistive joint system products bear classification marking of qualified testing agency.
b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
   1) UL in its "Fire Resistance Directory."

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

PART 2 – PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:

1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.

C. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

D. VOC Content: Provide fire-resistive joint systems that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
   a. Contractor's name, address, and phone number.
   b. Designation of applicable testing agency.
   c. Date of installation.
   d. Manufacturer's name.
   e. Installer's name.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.6 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory". Where NER-classified systems are indicated they refer to system numbers evaluated by ICC Evaluation Service, Inc.

B. Install Firestop Joint Systems as followed at rated walls:

C. Head of New Concrete Masonry Unit Wall at Existing Concrete Structure above: UL-Classified System No. HW-D-1001.

D. Wall-to-Wall Juncture between New Concrete Masonry Unit Wall and Existing Concrete Wall or Existing Masonry Walls: UL-Classified System No. WW-D-0032.

END OF SECTION 07844

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SECTION 07920
JOINT SEALANTS

PART 1 – GENERAL

1.1 SCOPE

A. The work under this section includes all labor, material, equipment and related services necessary to install joint sealants and associated components. Joint sealants for applications indicated in the Joint Sealant Schedule at the end of Part 3.

1.2 RELATED WORK

A. Applicable provisions of Division 1 shall govern work under this Section. The Contractor shall consult these provisions in detail prior to proceeding with work.

1. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
2. Division 08 Section “Hollow Metal Doors and Frames”.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.6 SUSTAINABILITY

A. All adhesives and sealants used on the interior of the building (defined as inside of the weatherproofing system and applied on-site shall comply with the requirements of the following reference standards –

1. Adhesives, Sealants and Sealant Primers: Limit VOC's per South Coast Air Quality Management District (SCAQMD) Rule #1168.

1.7 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40°F (5°C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

2.3 LATEX JOINT SEALANTS

A. Acrylic latex or siliconized acrylic latex sealant. Comply with ASTM C 834, Type OP, Grade NF.

B. Products:

1. Pecora Corporation; AC-20+.
2. Sonneborn, Division of ChemRex Inc.; Sonolac.
3. Tremco; Tremflex 834.

2.4 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

   a. Concrete.
   b. Masonry.
   c. Stone and precast.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

   a. Metal.
   b. Glass.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
   a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

B. Notify City Project Representative in writing with locations of newly applied joint sealants. Coordinate and provide barriers as necessary to protect applied sealant from personnel contact. Maintain barriers until sealant is cured.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors.

1. Joint Sealant: Latex sealant
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07920

SECTION 08111
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section includes all labor, supervision, material, equipment and related services necessary to furnish and install standard hollow metal doors and frames.

1.2 RELATED WORK

A. Applicable provisions of Division 1 shall govern all work under this Section. The Contractor shall consult these provisions in detail prior to proceeding with work.

1. Division 08 Section "Door Hardware" for door hardware and weather stripping.
2. Division 09 Section "Painting" for field painting factory-primed doors and frames.

1.3 DEFINITIONS

A. Steel Sheet Thicknesses: Thickness dimensions, including those referenced in ANSI A250.8, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

A. Product Data: For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fire-resistance ratings, and finishes.

B. Shop Drawings: Show the following:

1. Elevations of each door design.
2. Details of doors including vertical and horizontal edge details.
3. Frame details for each frame type including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.

C. Door Schedule: Use same reference designations indicated on Plans in preparing submittal schedule for doors and frames.

1.5 QUALITY ASSURANCE

A. Steel Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.

B. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in the furnace shall be established at 40 inches or less above the sill. Assembly shall have a maximum transmitted temperature end point of not more than 450 degrees F (250 degrees C) above the ambient at the end of 30 minutes of standard fire test exposure.

D. Install hardware per ADA guidelines and ANSI A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Inspect doors and frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4-inch- high wood blocking. Avoid using un-vented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS) or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.2 DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

B. Design: Flush panel.

C. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.

1. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

D. Vertical Edges for Single-Acting Doors: Manufacturer's standard.
1. Beveled Edge: 1/8 inch in 2 inches.

E. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.

F. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

G. Level 4 and Physical Performance Level A (Maximum Duty), Model 1 (Full Flush).

H. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

2. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.3 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Interior Frames: Fabricated from cold-rolled steel sheet.
1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Frames for Level 4 Steel Doors: 0.067-inch- thick steel sheet.

C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.4 FRAME ANCHORS

A. Jamb Anchors:
1. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8 inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 STOPS AND MOLDINGS

A. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

2.6 ACCESSORIES

A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.7 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate standard hollow metal work to tolerances indicated in SDI 117 and custom hollow metal work to tolerances indicated in ANSI/NAAMM-HMMA 861.

C. Hollow Metal Frames:

1. Frames shall be welded frames. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. All joints shall be continuously filled, dress, sealed and made smooth, flush, and invisible and weathertight..

2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

5. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Postinstalled Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Two anchors per jamb up to 60 inches high.
2) Three anchors per jamb from 60 to 90 inches high.
3) Four anchors per jamb from 90 to 120 inches high.
4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

D. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

F. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8 for standard doors and ANSI/NAAMM-HMMA 861 for custom doors.

1. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.

2. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
3. Coordinate locations of conduit and wiring boxes for electrical connections.

2.8 FINISHES

A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

C. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

D. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

E. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

F. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

G. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 for standard frames and HMMA 840 for custom frames.

C. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

1. At fire-protection-rated openings, install frames according to NFPA 80.
2. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
3. Install frames with removable glazing stops located on secure side of opening.
4. Install door silencers in frames before grouting.
5. Remove temporary braces necessary for installation only after frames have been properly set and secured.
6. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
7. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

D. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

E. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

F. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.

b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.

c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.

d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

K. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

G. Remove grout and other bonding material from hollow metal work immediately after installation.

H. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 08111

SECTION 08700
DOOR HARDWARE

PART 1 - GENERAL

1.6 SCOPE

A. Finish hardware for doors as specified or indicated and as listed in "Hardware Groups" and required by actual conditions. Include screws, special screws, bolts, special bolts, expansion shields, and other devices for proper application of hardware.

1.7 RELATED WORK

A. Applicable provisions of Division 1 shall govern work under this Section. The Contractor shall consult these provisions in detail prior to proceeding with work.

1. Division 08 Section “Hollow Metal Doors and Frames”

1.8 GENERAL REQUIREMENTS

A. Provide items, articles, materials, operations and methods listed, mentioned or scheduled herein or on drawings, in quantities as required to complete project. Provide hardware that functions properly. Prior to furnishing hardware, advise Architect of items that will not operate properly, are improper for conditions, or will not remain permanently anchored.

1.9 SUBMITTALS

A. Hardware Schedule: Submit required copies of hardware schedule in vertical format for purpose of preliminary review and acceptance. Schedules which do not comply will be returned for correction before checking. Hardware schedule shall clearly indicate architect's hardware group and manufacturer of each item proposed. List shall contain hardware item, base metal, finish, hand, size, and type number.

1. Provide 2 copies of illustrations for each item from manufacturer’s catalogs and data in brochure form.
2. Check specified hardware for suitability and adaptability to details and surrounding conditions. Indicate unsuitable or incompatible items and proposed substitutions in hardware schedule.
3. Provide listing of manufacturer's template numbers for each item of hardware in hardware schedule.
4. Furnish other Contractors and Subcontractors concerned with copies of final approved hardware schedule. Submit necessary templates and schedules as soon as possible to hollow metal, wood door, and aluminum door fabricators in accordance with schedule they require for fabrication.

B. Installation Instructions: Provide manufacturer's written installation and adjustment instructions for finish hardware. Send installation instructions to site with hardware.

1. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

2. Contract Closeout Submittals: Comply with General and Supplementary Conditions and Division 1 Specification Sections.
3. Operating and maintenance manuals: Submit sets containing the following:

   a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Name, address, and phone number of local representative for each manufacturer.
   d. Parts list for each product.
   e. Copy of final approved hardware schedule, edited to reflect "As installed" conditions.
   f. Copy of final keying schedule.

1.10 QUALITY ASSURANCE

A. Manufacturer: Obtain each type of hardware (e.g., latch and locksets, hinges, closers) from single manufacturer, although several may be indicated as offering products complying with requirements.

B. Supplier: Recognized architectural finish hardware supplier, with warehousing facilities, who has been providing hardware for period of not less than 3 years, and who is, or who employs a certified architectural hardware consultant (AHC) who is available, at reasonable times during course of work, for consultation about project's hardware requirements. Hardware schedule shall be prepared and signed by a certified AHC.

C. Installer: Firm with 3 years experience in installation of similar hardware to that required for this project, including specific requirements indicated.

D. Regulatory Label Requirements: Provide nationally recognized testing agency label or stamp on hardware for labeled openings. Where UL requirements conflict with drawings or specifications, hardware conforming to UL requirements shall be provided. Conflicts and proposed substitutions shall be clearly indicated in hardware schedule.

1.11 DELIVERY, STORAGE AND HANDLING

A. Deliver hardware to jobsite in manufacturer's original packaging, marked to correspond with approved hardware schedule. Do not deliver hardware until suitable locked storage space is available. Check hardware against reviewed hardware schedule. Store hardware to protect against loss, theft or damage.

B. Deliver hardware required to be installed during fabrication of hollow metal, aluminum, wood, or stainless steel doors prepaid to manufacturer.

1.12 WARRANTY

A. Guarantee workmanship and material provided against defective manufacture. Repair or replace defective workmanship and material appearing within period of one year after Substantial Completion.

B. Provide 5 year factory warranty on door closers against defects in material and workmanship from date of occupancy of Project.

C. Replace shortages and incorrect items with correct material at no additional cost to Owner.

D. At completion of project, qualified factory representative shall inspect closer installations. After this inspection, letter shall be sent to Architect reporting on conditions, verifying that closers have been properly installed and adjusted.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Listed acceptable alternate manufacturers: submit for review products with equivalent function and features of scheduled products.

ITEM:	MANUFACTURER:	ACCEPTABLE SUB:
Hinges	(IVE) Ives	McKinney, Stanley
Exit Devices	(VON) Von Duprin	Sargent, Precision
Electric Strikes	(VON) Von Duprin	Folger_Adam
Closers	(LCN) LCN	Norton, Yale
Kickplates	(IVE) Ives	Hiawatha, Trimco

B. Provide hardware items required to complete the work in accordance with these specifications and manufacturers' instructions.

1. Include items inadvertently omitted from this specification. Note these items in submittal for review. There will not be any extra's allowed for items that should have been picked up during bidding.
2. Where scheduled item is now obsolete, bid and furnish manufacturers updated item at no additional cost to the project.

2.2 HANGING MEANS:

A. Conventional Hinges: Hinge open widths minimum, but, of sufficient throw to permit maximum door swing. Steel or stainless steel pins and concealed bearings.

1. Three hinges per leaf to 7 foot, 6 inch height. Add one for each additional 30 inches in height, or any fraction thereof.
2. Extra heavy weight hinges on doors over 3 foot, 5 inches in width.
3. Outswinging exterior doors: non-ferrous with non-removable (NRP) pins.
4. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.
5. Provide shims and shimming instructions for proper door adjustment.
6. Scheduled Hinges are Ives 5BB1
7. Finish of hinges is to be (626)
8. Accepted substitutions: McKinney TB2714, Stanley FBB179

2.3 EXIT DEVICES/PANIC HARDWARE

A. General features:

1. Independent lab-tested 2,000,000 cycles.
2. Push-through touch pad design. No exposed touch bar fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
3. ¾" throw deadlocking latchbolts.
4. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.
5. Releasable with 32 lb. maximum pressure under 250 lb. load to the door.
6. Heavy cast metal flush mounted end caps finished to match exit device.

B. Specific features:

1. Lever Trim: Breakaway type (996L), forged brass or bronze escutcheon min .130" thickness, match lockset lever design.
2. Furnish one 98/99MK parts maintenance kit per project.
3. Scheduled Exit Device: Von Duprin 98 series
4. Finish of Exit Devices is to be (626)

C. Power Supplies: Power supplies are to provide filtered, regulated power to operate electrical products including electrified exit devices. Output power is to be field-selectable for either 24VDC @ 2.0 ampere or 12VDC @ 4.0 ampere. Standard input is to be 120VAC @ 1.0 ampere or 240VAC @ 0.5 ampere. Steel enclosure shall incorporate key lock and have minimum quantity of five knockout holes for conduit connection. Terminal block to accept up to 14 gauge wire.

1. Scheduled Power Supplies: Von Duprin PS914-2Q

2.4 CLOSERS

A. General: One manufacturer for closer units throughout the Work, including surface closers, high security closers, overhead concealed closers, floor closers, low-energy door operators and electromagnetic hold-open closers.

B. Surface Closers:

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 8,000,000 cycles.
4. Thru-bolts at wood doors unless doors are provided with closer blocking. Non-sized, non-handed, and adjustable. Place closer inside building, stairs and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Opening pressure: Exterior doors 8.5 lb., interior doors 5 lb., labeled fire doors 15 lb.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at all doors requiring parallel arm units.
9. Non-flaming fluid will not fuel door or floor covering fires.
10. Scheduled Closer: LCN 4041

2.5 OTHER HARDWARE

A. Kick Plates: Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.

1. Scheduled kick plates are: Ives 8400

2.6 KEYING

A. Prior to lockset installation, provide removable core cylinders for each lockset to Owner. Owner will key cylinders and return cylinders to Contractor for installation. Contractor shall not retain keys to locksets. All keys must be returned to Owner.

2.7 FASTENERS

A. Including, but not limited to, wood or machine screws, bolts, bolts, nuts, anchors, etc. of proper type, material, and finish required for installation of hardware. Fasteners shall be non-corrosive.

B. Use Phillips head for exposed screws. Do not use aluminum screws to attach hardware.

C. Provide Philips flat head screws with finished heads to match surface of door hardware.

D. Provide self-tapping (TEC) screws for attachment of sweeps and stop-applied weatherstripping.

E. Provide new fasteners for the installation of existing hardware. Provide fasteners of style and material as was originally provided with hardware.

2.8 TYPICAL FINISHES AND MATERIALS

A. Standard: Comply with BHMA A156.18. The intent is to match the finish of the existing door hardware BHMA 626.

PART 3 – EXECUTION

3.6 EXAMINATION

A. Examine doors, frames, and related items for conditions that would prevent the proper application of finish hardware. Do not proceed until defects are corrected.

3.7 INSTALLATION

A. Install finish hardware in accordance with reviewed hardware schedule and manufacturer's printed instructions. Prefit hardware before finish is applied, remove and reinstall after finish is completed. Install hardware so that parts operate smoothly, close tightly and do not rattle.

B. Installation of hardware shall comply with NFPA 80 and NFPA 101 requirements.

C. Set units level, plumb and true to line and location. Adjust and reinforce attachment to substrate as necessary for proper installation and operation.

D. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant, forming a weathertight seal between threshold and surface to which it is set. Securely and permanently anchor thresholds, using countersunk non-ferrous screws to match color of thresholds (stainless steel screws at aluminum thresholds).

F. Re-connect all existing electrified hardware devices that had been disconnected for door and hardware installation.

3.8 FIELD QUALITY CONTROL

A. After installation has been completed, provide services of qualified hardware consultant to check Project to determine proper application of finish hardware according to schedule. Also check operation and adjustment of hardware items.

3.9 ADJUSTING AND CLEANING

A. At final completion, hardware shall be left clean and free from disfigurement. Make final adjustment to door closers and other items of hardware. Where hardware is found defective repair or replace or otherwise correct as directed.

B. Adjust door closers to meet opening force requirements of Uniform Federal Accessibility Standards.

C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of space or area, return to work during week prior to acceptance or occupancy, and make final check and adjustment of hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.

D. Instruct Owner's personnel in proper adjustment and maintenance of door hardware and hardware finishes.

E. Clean adjacent surfaces soiled by hardware installation.

3.10 PROTECTION

A. Provide for proper protection of items of hardware until Owner accepts Project as complete.

3.11 HARDWARE GROUPS

A. The following schedule of hardware groups shall be considered a guide only, and the supplier is cautioned to refer to general conditions, special conditions, and the preamble to this section. It shall be the hardware supplier's responsibility to furnish all required hardware.

HARDWARE GROUP 1
3 each Hinges
1 each Fire Exit Hardware - Cylindrical (with storage function fixed lever on outside and request to exit)
1 each Rim Cylinder
1 each Electric Strike
1 each Power Supply
1 each Closer (Interior mounted)
1 each kickplate 12" high
1 each card Reader (to be provided, installed and connected to existing security system by Division 26 Electrical)

END OF SECTION 08700

SECTION 09900
PAINTING AND COATINGS (PROFESSIONAL LINE PRODUCTS)

PART 1 – GENERAL

1.1 SCOPE

A. The work under this section includes all labor, supervision, material, equipment and related services necessary to provide surface preparation and field painting of exposed exterior and interior items and surfaces where indicated.

1.2 SUMMARY

A. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Painting includes field painting of new hollow metal doors and frames; new wall surfaces where designated to be painted.

1. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1. Division 08 Section "Steel Doors and Frames" for factory priming steel doors.

1.4 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this Section.

B. The objective of this painting specification is to produce a uniform coating which will remain sound and free from visible defects for a period of not less than 10 years, and which can be renewed by application of additional coats without extensive or costly surface preparation.

C. Sheen/gloss level definitions meeting Architects aesthetic expectations following ASTM D523 procedures:

1. Flat 0 - 10 units at 85 degree geometry
2. Eggshell (satin) 11 - 25 units at 85 degree geometry

3. Low Sheen semi-gloss 26 - 42 units at 85 degree geometry
4. High Sheen semi-gloss 43 - 59 units at 85 degree geometry
5. Gloss 60 - 79 units at 85 degree geometry
6. High Gloss 80 - 95 units at 85 degree geometry

1.5 SUBMITTALS

A. Product Data: For each paint system indicated.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
3. Submit three draw down samples, 8 x 10 inches in size for each color selected.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45°F (7°C). Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

PROJECT CONDITIONS

C. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90°F (10 and 32°C).

D. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95°F (7 and 35°C).

E. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5°F (3°C) above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: Quantity equal to 1% (Min. 1 full gallon of each color) of quantity installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Benjamin Moore & Co. (Benjamin Moore).
2. Glidden Professional.
3. PPG Industries, Inc. (Pittsburgh Paints).
4. Sherwin-Williams Co. (Sherwin-Williams).

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: As selected by Owner from full range.

2.3 CONCRETE UNIT MASONRY BLOCK FILLERS

A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.

1. Benjamin Moore; Moorcraft Super Craft Latex Block Filler No. 285: Applied at a dry film thickness of not less than 8.1 mils (0.206 mm).
2. Glidden Professional; Bloxfil 4000-1000 Interior/Exterior Heavy Duty Acrylic Block Filler: Applied at a dry film thickness of not less than 7.0 to 14.5 mils (0.178 to 0.368 mm).
3. Pittsburgh Paints; 6-7 SpeedHide Interior/Exterior Masonry Latex Block Filler: Applied at a dry film thickness of not less than 6.0 to 12.5 mils (0.152 to 0.318 mm).
4. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils (0.203 mm).

2.4 INTERIOR PRIMERS

A. Interior Existing Unpainted Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex interior acrylic primer for interior application. Seals and adheres to concrete, brick, mortar and plaster.

1. Benjamin Moore; Moore's Super Spec 100% Acrylic Masonry Sealer 066: Applied at a dry thickness rate per manufacturer’s recommendations.
2. Glidden Professional; Concrete Coatings Bond-Prep 3030 Pigmented Bonding Primer: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

3. Pittsburgh Paints; Perma-Crete Concrete and Stucco Primer 4-503: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm) per coats.
4. Sherwin-Williams; Loxon Concrete and Masonry Primer B24W8300: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm) per coats.

B. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.

1. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
2. Glidden Professional; 4160-6130 Devguard Multi-Purpose Tank & Structural Primer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
3. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
4. Sherwin-Williams; Kem Kromik Universal Metal Primer B50NZ6/B50WZ1: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

C. Interior Primer for Previously Painted Surfaces: Factory-formulated quick-drying multi-purpose latex primer sealer.

1. Benjamin Moore; Moore's Fresh Start Premium Primer Low VOC 023: Applied at a dry thickness rate per manufacturer’s recommendations.
2. Pittsburgh Paints; 17-921 Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer: Applied at a dry film thickness of not less than 1.6 mils (0.040 mm).
3. Glidden Professional; Gripper 3210 Interior/Exterior Water Based Primer Sealer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
4. Sherwin-Williams; B51W450 Multi-Purpose Zero VOC Interior/Exterior Latex Primer Sealer; Applied at a dry film thickness of not less than 1.4 mils (0.038 mm).

2.5 METAL SURFACE

A. Interior and Exterior Hollow Metal Doors and Frames: Factory-formulated full-gloss waterborne acrylic-latex enamel for exterior application.

1. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M28: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm) per coat.
2. ICI Dulux Paints; 3028-XXXX Dulux Interior/Exterior Acrylic Gloss Finish: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

3. Pittsburgh Paints; 90-300 Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamels: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).
4. Sherwin-Williams; DTM Acrylic Coating Gloss (Waterborne) B66W100 Series: Applied at a dry film thickness of not less than 2.4 mils (0.061 mm) per coating.

2.6 INTERIOR FINISH COATS

A. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.

1. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel No. 276: Applied at a dry film thickness of not less than 1.2 mils (0.031 mm).
2. ICI Dulux Paints; 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
3. Pittsburgh Paints; 6-500 Series SpeedHide Interior Semi-Gloss Latex: Applied at a dry film thickness of not less than 1.0 mil (0.025 mm).
4. Sherwin-Williams; ProMar 200 Interior Latex Semi-Gloss Enamel B31W200 Series: Applied at a dry film thickness of not less than 1.3 mils (0.033 mm).

B. Interior Full-Gloss Alkyd Enamel for Wood and Metal Surfaces: Factory-formulated full-gloss alkyd interior enamel.

1. Benjamin Moore; Moore's IMC Urethane Alkyd Enamel No. M22: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
2. ICI Dulux Paints; 4308-XXXX Devguard Alkyd Industrial Gloss Enamel: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
3. Pittsburgh Paints; 7-814 Series Pittsburgh Paints Industrial Gloss-Oil Interior/Exterior Enamel: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
4. Sherwin-Williams; ProMar 200 Alkyd Gloss Enamel B35W200 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, existing exterior plaster soffits, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Remove all loose paint from existing surfaces to be painted.
b. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
c. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.

3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

   a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
   b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

4. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

F. Existing Surfaces: Preparation of existing surfaces to receive painting and/or wallcoverings shall be Contractor's responsibility. Remove and replace attachments to existing surfaces that require finishing if said attachments are not to be painted with wall. Wash existing surfaces. Remove all loose, blistered, or otherwise defective paint. Sand surfaces smooth where chipped surfaces occur. Prepare specific surfaces as indicated above.

G. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
2. Provide finish coats that are compatible with primers used.
3. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces.
5. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Sand lightly between each succeeding enamel coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

F. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

G. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:

1. Owner may engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
2. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 PAINT SCHEDULE

A. CONFIRM COLOR AND SHEEN WITH OWNER AND ON SITE.

B. New Hollow Metal Doors And Frames: Provide the following finish systems over the interior and exterior surfaces of the new hollow metal doors and frames:

1. Factory-formulated full-gloss waterborne acrylic-latex enamel: Two finish coats over a factory applied primer.

a. Primer: Factory applied rust resistant primer.
b. Finish Coats: Factory-formulated full-gloss waterborne acrylic-latex enamel.

C. Existing Interior Concrete and Masonry other than concrete unit masonry (Previously not painted): Provide the following paint systems over interior concrete and brick masonry substrates:

1. Interior Semi-Gloss Acrylic Enamel Finish: Two finish coats over Interior Existing Concrete and Masonry Primer.

a. Primer: Factory-formulated alkali-resistant acrylic-latex interior acrylic primer
b. Finish Coats: Interior semi-gloss acrylic enamel

D. Interior Concrete Unit Masonry (Previously not painted): Provide the following finish systems over interior concrete masonry:

1. Semigloss Acrylic-Enamel Finish: Two finish coats finish coats over block filler.

a. Block Filler: Concrete unit masonry block filler.
b. Finish Coats: Interior semi-gloss acrylic enamel.

E. Previously Painted Surfaces: Provide the following finish system over previously painted concrete, masonry and concrete masonry.

1. Interior Semi-Gloss Acrylic Enamel Finish: Two finish coats over interior primer for previously painted surfaces.

a. Primer: Factory-formulated quick-drying multi-purpose Zero VOC latex primer sealer.
b. Finish Coats: Interior semigloss acrylic enamel.

END OF SECTION 09900

SECTION 15000C

COMMON WORK RESULTS FOR FIRE SUPPRESSION

1. PART 1 – GENERAL

1.01. SCOPE

A. This section includes information common to two or more technical fire protection specification sections or items that are of a general nature, not conveniently fitting into other technical sections.

1.02. RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions, and the applicable provisions of Division 1, govern work under this section.

B. This section applies to all Division 21 sections of the fire protection specifications.

1.03. GENERAL STANDARDS

A. Abbreviations of standards organizations referenced in this and other sections are as follows:

AGA	American Gas Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWS	American Welding Society
CGA	Compressed Gas Association
EPA	Environmental Protection Agency
FM	Factory Mutual
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
MCA	Mechanical Contractors Association
MICA	Midwest Insulation Contractors Association
MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
NBS	National Bureau of Standards
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
UL	Underwriters Laboratories, Inc.

1.04 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, "Equals and Substitutions".

B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be used unless specifically indicated.

C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, rating or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

1.06 CODES AND PERMITS

A. The work shall conform to all requirements of the Wisconsin Administrative Code (along with all local codes and standards), International Building Codes, City of Milwaukee, NFPA Standards, Insurance Underwriter, and Local Fire Chief or Fire Marshal (AHJ, Authority Having Jurisdiction) regarding design, materials and installation.

B. Obtain and pay for all permits or licenses required under this contract, including all state and local installation inspections and plan review. Deliver originals of these certificates to the Owner / Architect. Include copies of certificates, permits and payments of the same to the Owner, and provide a separate set of copies in the Operating and Maintenance Manual.

1.07 QUALITY ASSURANCE

A. Refer to the Instructions to Bidders, General Conditions, and the applicable sections of Division 1 for requirements in selecting products and requesting substitutions.

B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.

C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

1.08 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

1.09 SEALING AND FIRESTOPPING

A. Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and

fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.10 PROTECTION OF FINISHED SURFACES

A. Refer to Division 1, General Requirements, "Protection of Finished Surfaces".

1.11 SLEEVES AND OPENINGS

A. Refer to Division 1, General Requirements, "Sleeves and Openings".

1.12 SUBMITTALS

A. Refer to Division 1, General Conditions, "Submittals".

B. Refer to the General and Supplementary Conditions and the applicable sections of Division 1 for submittal definitions, requirements, and procedures. Submittals of shop drawings and product data will be accepted only when submitted by the Contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.

C. Prepare additional floor plans, elevations, sections, and details necessary to conclusively coordinate and integrate all fire protection installations. Include locations where space is limited, and where sequencing and coordination of installations are of importance to other trades.

D. Contractor shall provide Fire Protection System Data Sheets for the following components: pipe, fittings, hangers & supports, sprinkler heads, valves, specialty valves, pipe specialties, fire protection specialties, fire protection equipment

E. Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically powered equipment.

F. Submittals shall be sent to the Local Fire Chief / Fire Marshal or the Department of Safety and Professional Services for review after review by the Architect/Engineer. Include copy of approval letter in submission to Architect/Engineer. A final copy of the AHJ approved submittal shall be provided to the Architect/Engineer for record.

G. Submit plans indicating water supply location and size, piping layout and size, sprinkler locations and type, hanger locations and type, equipment locations and type, valve locations and type, occupancy classes, hydraulic reference points, design areas and discharge densities.

H. Submit hydraulic calculations for water supply and sprinkler systems. Include summary sheet and detailed work sheets. Describe characteristics of water supply and location of effective point used in calculations. Include graph illustration of water supply, hose demand, sprinkler demand

and in-rack sprinkler demand. Where a fire pump is used, graph primary rating point, secondary rating point and churn pressure of pump and combined water supply.

I. Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:

1. Operating and Maintenance Manuals	2 copies
2. Owner	1 copy
3. Architect/Engineer	1 copy
4. Local Fire Chief or Marshal	1 copy

J. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically powered equipment.

1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Refer to Division 1, General Requirements, "Operating and Maintenance Instructions".

B. Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the applicable sections of Division 1, include the following information.

1. Copies of all approved shop drawings.
2. Manufacturer's wiring diagrams for electrically powered equipment.
3. Records of tests performed to certify compliance with system requirements.
4. Certificates of inspection by regulatory agencies.
5. Parts list for fixtures, manufactured equipment, valves and specialties.
6. Manufacturers' installation, operation and maintenance recommendations for fixtures, manufactured equipment, valves and specialties.
7. Valve schedules.
8. Lubrication instructions, including list/frequency of lubrication.
9. Additional information as indicated in the technical specification sections.
10. Warranties.

1.14 TRAINING OF OWNER PERSONNEL

A. Instruct Owner personnel in the proper operation and maintenance of systems and equipment as provided as part of this project, using the Operating and Maintenance Manual during this instruction. Include not less than eight hours of instruction, in two four (4) hour shifts to permit all owner staff to receive training. Demonstrate startup, operation and shutdown procedures for all equipment. All training shall be completed during normal working hours.

1.15 RECORD DRAWINGS

A. Refer to Division 1, General Requirements, "Record Drawings".

B. In addition to the data indicated in the General Requirements, maintain fire protection layout record drawings and hydraulic calculations on originals prepared by the installing contractor / subcontractor. Maintain at the site an up-to-date, marked set of "As-Built" or "Record" drawings, which shall be corrected and delivered to the Architect/Engineer upon completion.

C. Furnish Owner with one reproducible print of record drawings revised to indicate "As-Built" conditions.

D. Include copies of the "Record" drawings and calculations with the Operating and Maintenance manuals.

1.16 HOUSEKEEPING AND CLEANUP

A. Refer to the applicable sections of Division 1, including "Project Closeout" and/or "Final Cleaning" for general requirements for final cleaning.

B. Periodically as work progresses and/or as directed by the Architect/Engineer, the Contractor shall remove waste materials from the building and leave the area of the work broom clean. Upon completion of work remove all tools, scaffolding, broken and waste materials, etc., from the site.

1.17 FIRE PROTECTION

A. Provide fire extinguishers of types and size recommended by NFPA 10. Provide special fire-prevention supervision of welding, cutting, and other hazardous operations. Place permanent fire protection facilities in operation at earliest date possible.

1.18 GUARANTEE

A. The Contractor, by acceptance of this contract, guarantees all labor and materials, provided hereunder and shall at his expense repair, remodel, rebuild, replace and/or rewire and further make good and acceptable all labor and materials found defective within one year from the date of final acceptance or found in violation of applicable Codes or regulations, in force at the time of bidding, within five years from said date.

B. Guarantee that systems will operate without objectionable noise, vibration, and uncontrolled expansion.

C. Repair, replace, or alter systems or parts of systems found defective at no extra cost to the Owner.

2. PART 2 – PRODUCTS

2.01. ACCESS PANELS AND DOORS

A. Lay-in Ceilings: Removable lay-in ceiling tiles in 2 ft by 2 ft (2′ x 2′) or 2 ft by 4 ft (2′ x 4′) configuration provided under Section 09500 are sufficient; no additional access provisions are required unless specifically indicated.

B. Plaster Walls and Ceilings: 16-gauge frame with not less than a 20-gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 16" x 16".

C. Key locks for access panels and doors throughout the facility shall be matched for access by a single master key.

2.02. IDENTIFICATION

A. Acceptable Manufacturers: Subject to compliance with requirements, provide mechanical identification materials by Allen Systems, W. H. Brady Co., Industrial Safety Supply Co., EMED Co., or Seton Name Plate Corp.

B. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Stencils: Not less than ½-inch high letters for pipe sizes 1-inch through 2 ½-inches, and not less than 1-inch high letters/numbers for pipe sizes 3-inches and above for marking pipe and equipment. Apply follow arrows to piping.

D. Engraved Name Plates: White letters on a black background, 1/16-inch thick plastic laminate, beveled edges, screw mounting; Setonply Style 2060 by Seton Name Plate Company, Emedolite Style EIP by EMED Co., or approved equal.

E. Adhesive Labels: Pressure-sensitive, adhesive backed, vinyl pipe markers with applicable labeling, ¾-inch minimum size for lettering and surrounding tape on both ends, with flow arrows on piping. Conforming to ANSI, ANSI and NFPA standards. Seton Opti-Coe, or equal. Clear piping before application.

F. Snap-Around Pipe Markers: One-piece, vinyl construction, snap-around or strap-around pipe markers with applicable labeling and flow direction arrows, ¾-inch minimum size for lettering. Provide nylon ties on each end of pipe markers. Equal to Seton Setmark.

G. Signs: Metal construction, baked porcelain enamel finish signs, sizes conforming to NFPA No. 13 and 7-1.2, with holes and "S" hooks/chains for hanging or securing, with applicable labeling. Seton or equal.

H. Valve Tags: Round, 19-gauge polished brass valve tags with ½-inch numbers, ¼-inch system identification abbreviation, 1 ½-inch minimum diameter, with manufacturer's standard solid brass jack chains or solid brass "S" hooks of the sizes required for proper attachment of tags to valve stems available from EMED Co., Seton Name Plate Company, or W.H. Brady.

2.03. SEALING AND FIRESTOPPING, FIRE AND/OR SMOKE RATED PENETRATIONS

A. Acceptable manufacturers include 3M, Hilti, Rectorseal, STI/SpecSeal, Tremco, or approved equal. All firestopping systems shall be provided by the same manufacturer.

B. All firestopping systems shall be UL listed.

C. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.

D. Use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop blocks, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

E. Submittals: Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawing for UL system with know performance for which an engineering judgment can be based upon.

2.04. SEALING AND FIRESTOPPING, NON-RATED PENETRATIONS

A. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water-stop type wall sleeve. The operating bolts of the mechanical type seal shall be accessible from the interior of the building.

B. At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not required, use urethane caulk in annular space between pipe insulation and wall material.

3. PART 3 – EXECUTION

3.01. CUTTING AND PATCHING

A. Refer to Division 1, General Requirements, "Cutting and Patching".

B. Patching includes repairing the openings remaining from the removal or relocation of existing system components and painting the surface to match existing. Painting means covering the entire surface where painting is to be done unless indicated to be done by other trades.

C. Do not pierce beams or columns without permission of the Architect/Engineer and then only as directed. If any piping is required through walls or floors where no sleeve has been provided, use a core drill to avoid all unnecessary damage and structural weakening. Any penetration through a structural member must be approved (in writing) by the Structural Engineer. The Contractor responsible for damage and/or structural weakening shall be fully responsible for the cost of the damages and/or repairs.

3.02. CONCRETE WORK

A. Cast-in-place concrete within the building will be performed by this Contractor in conformance with requirements of Division 3. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for support or installation of fire suppression piping, piping, specialties, equipment pads, etc.

B. Fire protection related cast-in-place concrete on the exterior of the building to be provided by this Contractor in conformance with requirements of Division 3. This includes piping thrust restraints, pipe supports, equipment pads, etc.

3.03. BUILDING ACCESS

A. Arrange for the necessary openings in the building to allow for admittance or removal of all apparatus. When the building access was not previously arranged and must be provided by the Contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.04. EQUIPMENT ACCESS

A. Install all piping, conduit, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster walls or ceilings, furnish the access doors to the General Contractor.

3.05. COORDINATION

A. Coordinate all work with other contractors prior to installation. The contractor shall consult closely with all other trades to coordinate installation of heating and ventilating, plumbing, fire protection, and electrical work. Any work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

B. Coordinate alarm operation, controls, and electrical interlocks with the Owner to maintain required security functions and maintain building safety.

C. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work.

D. Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

E. Coordinate locations of sleeves, openings, chases, furred spaces, etc., with the building Contractor. Furnish and install during progress of construction all sleeves, hangers, inserts, etc., that are to be built into the structure.

F. Contractors and subcontractors shall closely and carefully review all construction documents. Information regarding the complete work is dispersed throughout the document set and cannot be accurately determined without reference to the complete drawing set.

3.06. IDENTIFICATION

A. Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black enamel against a light background or white enamel against a dark background. Use a primer where necessary for proper paint adhesion.

B. Where stenciling is not appropriate for equipment identification, engraved nameplates may be used.

C. Identify interior piping not less than once every 25 feet, not less than once in each room, adjacent to each access door or panel, and on both sides of the partition where accessible piping passes through walls or floors. Place flow directional arrows at each pipe identification location. Use one coat of black enamel against a light background or white enamel against a dark background.

D. Identify valves with signs per NFPA rulings.

E. Provide hydraulic design information sign of permanently marked weatherproof metal or engraved nameplate material. Secure to alarm valve with brass chain. Information to include location of the design areas, discharge densities, required flow and residual pressure at the base of riser, hose stream demand and sprinkler demand.

3.07. LUBRICATION

A. Upon completion of the work and before turning over to the Owner, clean and lubricate all bearings except sealed and permanently lubricated bearings. Lubricate bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason.

B. The Contractor is responsible for maintenance and lubrication of all mechanical equipment in accordance with the manufacturer's instructions until the work is accepted by the Owner. Maintain a log of all lubricants used and frequency of lubrication. Include this information in the Operating and Maintenance Manuals at the completion of the project.

3.08. SLEEVES

A. Provide galvanized sheet metal sleeves for pipe penetrations through interior and exterior walls to provide a backing for sealing or firestopping. Patch wall around sleeve to match adjacent wall construction and finish. Grout area around sleeve in masonry construction. In finished areas where pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall.

B. Pipe sleeves in new poured concrete construction shall be schedule 40 steel pipe (sized to allow insulated pipe to run through the sleeve), cast in place.

C. Pipe sleeves are not required in interior non-rated drywall, plaster or wood partitions and sleeves are not required in existing poured concrete walls where penetrations are core drilled.

D. In all piping floor penetrations, fire rated and non-fire rated, top of sleeve shall extend ¾ -inch above the adjacent finished floor. In existing floor penetrations, core drill sleeve opening large enough to insert schedule 40 sleeve and grout area around sleeve with hydraulic setting, non-shrink grout. If the pipe penetrating the sleeve is supported by a pipe clamp resting on the sleeve, weld a collar or struts to the sleeve that will transfer weight to existing floor structure.

3.09. SEALING AND FIRESTOPPING, FIRE AND/OR SMOKE RATED PENETRATIONS

A. Install approved product in accordance with the manufacturer's instructions where a pipe penetrates a fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier.

B. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support substantial weight.

3.10. SEALING AND FIRESTOPPING, NON-RATED PENETRATIONS

A. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, in accordance with manufacturer's instructions.

B. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.

END OF SECTION 15000C

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SECTION 15060C

FIRE SUPPRESSION PIPE AND PIPE FITTINGS

1. PART 1 – GENERAL

1.01. SCOPE

A. This section contains specifications for fire protection pipe and pipe fittings for this project.

1.02. RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions, and the applicable provisions of Division 1, govern work under this section.

1.03. RELATED WORK

A. The following technical fire protection specifications sections are directly related to the provisions of this section.

Section 15000C – Common Work Results for Fire Suppression
Section 15140C – Fire Suppression Hangers and Supports
Section 15300C – Water Based Fire Suppression Systems

1.04. REFERENCE STANDARDS

A. Specific standards referenced in this section are as follows:

ANSI A21.4	General Standard
ANSI A21.11	General Standard
ANSI A21.51	General Standard
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI B16.3	Malleable Iron Threaded Fittings
ANSI B16.4	Cast Iron Threaded Fittings
ANSI B16.5	Pipe Flanged and Flanged Fittings
ANSI B16.9	Factory Made Wrought Steel Buttweld Fittings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM A105	Forgings, Carbon Steel, for Piping Components
ASTM A126	Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A135	Electric Resistance Welded Steel Pipe
ASTM A181	Forgings, Carbon Steel for General Purpose Piping
ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A536	Ductile Iron Castings
ASTM A795	Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

ASW D10.9	Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR3
NFPA 13	Installation of Sprinkler Systems. (Latest prevailing addition)
NFPA 14	Installation of Standpipe and Hose Systems. (Latest prevailing addition)
UL	Underwriters' Laboratories Listing
FM	Factory Mutual Approval

1.05. SHOP DRAWINGS

A. Schedule from the contractor indicating the ANSI/ASTM specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

1.06. QUALITY ASSURANCE

A. Refer to General Conditions, applicable provisions of Division 1, and Section 15000c.

B. Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier. Each length of pipe shall be identified at mill by paint, stenciling, or raised symbols identifying manufacturer and class type or schedule of pipe. Copper pipe shall be identified at 3 foot intervals.

C. Fittings shall be identified by manufacturer by permanently attached tags, imprints or other approved means indicating class or wall thickness and material.

D. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

E. Conform to NFPA 13 for sprinkler systems.

F. Conform to NFPA 14 for standpipe and hose systems.

G. Conform to NFPA 20 for fire pumps.

H. Welding Materials and Procedures: Conform to ASME Code.

1.07. DELIVERY, STORAGE, AND HANDLING

A. Refer to General Conditions and Section 15000c.

B. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

C. Deliver products to site under the applicable provisions of Division 1 (Section 01600). Deliver and store valves and other components in the original shipping containers, with labeling in place.

D. Cover pipe to prevent corrosion and deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage or by durable, waterproof, above ground packaging.

E. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

F. Storage and protection methods must allow inspection to verify products.

1.08. DESIGN CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, specifications as listed in this specification.

B. Construct all piping for the highest pressures and temperatures in the respective system, but not less then 175 psig. If system pressure exceeds 175 psig, contractor shall use fittings, valves, and appurtenances rated for system pressure.

C. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having centerline radius of 1.5 pipe diameters.

D. Where ASTM A53 or A795 Type F pipe is specified, Grade A, Type E or S, or Grade B, Type E or S may be substituted at Contractor's option. Where ASTM A135 Grade A pipe is specified, Grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

1.09. WELDER QUALIFICATIONS

A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified welding procedures on the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.

B. The Architect or Engineer reserves the right to test the work of any welder employed on the project. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

2. PART 2 – PRODUCTS

2.01. GENERAL

A. Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or class) indicated for each service. Where type, grade or class is not indicated, provide

proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/Tube Fitting: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

C. All materials, including piping and fittings, shall be of domestic manufacture.

2.02. FIRE PROTECTION PIPING

2.02. 1. PIPING – BELOW GROUND

A. Ductile iron pressure pipe, mechanical joint, Class 52, 150 psi working pressure, ANSI Standard A21.51. Ductile iron fittings, ANSI Standard A21.11. Include cement mortar lining, ANSI Standard A21.4.

2.02.2. PIPING – ABOVE GROUND (STEEL PIPE)

A. Black steel pipe welded and seamless, Type F, Grade A, ASTM A53; black welded and seamless steel pipe for fire protection use, Type F, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135.

D. Lightwall, thinwall, and plastic piping materials are not acceptable.

E. Pipe Wall Thickness: Schedule 40 for welded, rolled groove, cut groove and threaded. Schedule 30 for welded, rolled groove, 8-inches and larger cut groove, and 8-inches and larger threaded piping.

F. Fittings: Cast iron threaded fittings, Class 125 or 250, ASTM A126/ANSI B16.4. Malleable and ductile iron threaded fittings, Class 150 or 300, ASTM A197/ANSI B16.3. Standard weight seamless carbon steel weld fittings, ASTM A234 grade, ANSI B16.9. Mechanical grooved fittings with EPDM gaskets, ASTM A536 ductile iron, ASTM A47 malleable iron or ASTM A53 fabricated steel. Mechanical tees with U-bolt back or other fastening means are not allowed.

G. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pre3ssure Vessel Code for welding materials.

H. Finish: Hot dipped zinc coated (galvanized) finish on <u>piping and fittings</u> shall be used in dry sprinkler or combined pipe systems, preaction systems, piping exposed to weather, concealed piping (chases, basement areas, crawlspaces, etc.), piping exposed to corrosive environments, and as otherwise indicated. Thread or cut groove hot dipped zinc and coated pipe ends for fitting connections. Refer to the list of corrosive environments outlined in Section 15140C (Corrosive Atmosphere Coatings) for a complete list of required locations.

2.03. UNIONS AND FLANGES

2.03.1. 2-INCHES AND SMALLER STEEL

A. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.

2.03.2. 2 ½-INCHES AND LARGER STEEL

A. ASTM A181 or A105, Class 150 grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast iron threaded flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with other flat face flanges on equipment.

2.04. MECHANICAL GROOVED PIPE CONNECTIONS

A. Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Victaulic, Nibco, ITT Grinnell or Gustin-Bacon may be used with steel pipe. Mechanical grooved components and assemblies to be rated for minimum 175 psi working pressure unless noted otherwise.

B. All mechanical grooved pipe material including gaskets, couplings, fittings and flange adaptors to be from the same manufacturer.

C. Couplings and fittings to be malleable iron, ASTM A47, or ductile iron A536 with painted finish. Fittings used on galvanized steel pipe to have galvanized finish, ASTM A153.

D. Gaskets to be EPDM, ASTM D2000. Gaskets for dry systems to be flush seal design. Heat treated carbon steel oval neck track bolts and nuts. ASTM A-183, with zinc electroplated finish.

E. Flange adapters to be ductile iron, ASTM A536; expect at lug type butterfly valves where standard threaded flanges shall be used.

F. Credit for the inherent flexibility of mechanical grooved pipe connection when used for expansion joints or flexible connectors may be allowed upon specific application by the Contractor. Three flexible couplings at first three connection points both upstream and downstream of pumps may be used in lieu of flexible connectors. Request for expansion joints shall be made in writing and shall include service, location, line size, proposed application and supporting calculations for the intended service.

2.05. PRESSURE SENSING LINE PIPE:

A. Seamless Red Brass pipe, ASTM 43, regular weight (Schedule 40), with ASTM B584 threaded copper alloy pressure fittings,

B. Type L copper water tube, H (drawn) temper, ASTM B88; with cast copper pressure fittings, ANSI B16.18; wrought copper pressure fittings, lead free (<.2%) solder, ASTM B32; flux, ANSI B16.22; copper phosphorous brazing alloy, AWS A5.8 BCuP.

3. PART 3 – EXECUTION

3.01. GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturers' recommendations and recognized industry practices.

3.02. PREPARATION

A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.03. ERECTION

A. Install piping in accordance with NFPA 13 for sprinkler systems, NFPA 14 for standpipe and hose systems, and NFPA 20 for fire pumps, along with all local fire prevention codes.

B. Install all piping parallel to building walls and ceilings and at heights that do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures and grilles before installing piping.

C. Piping and similar items shall be installed concealed from view above ceiling, in partitions, shafts, chases, etc. unless otherwise indicated. Where pipes are installed in partitions, furred out spaces, and chases, obtain information as to their exact location and size and install work so as to be entirely concealed in allotted space. Coordinate piping installation with General Contractor (and other trades sharing the same space) for routing within walls, ceilings, furred out spaces, chases, etc.

D. Where there is evidence that parts of the fire protection work will interfere with other work, assist in working out space conditions and/or structure, make necessary adjustments to accommodate work.

E. Fire protection work installed before coordinating with other work so as to cause interference with other work to be changed to correct such condition without additional cost to Owner.

F. In no case will any pipe, conduit, or duct be installed where it is supported on or suspended from another pipe, conduit, or duct.

G. Where piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation. Provide sleeves when penetrating floors and walls.

H. Maintain piping, fittings, and fire protection system components in clean condition internally during construction. All material shall be kept at proper temperature to assure proper jointing. Pipe and fittings shall be corresponding materials when assembled.

I. Provide clearance for access to valve and piping specialties to facilitate maintenance and repair or replacement.

J. Screw joint steel piping up to and including 1 ½" diameter. Screw or weld 2" diameter piping. Weld piping 2 ½" diameter and larger, including branch connections. Mechanical grooved joints may be used instead of threaded or welded joints.

K. In steel piping, main sized saddle branch connections or direct connection of branch lines to mains is permitted if main is one pipe size larger than branch (for up to 6" mains), and if main is two pipe sizes larger than branch (for 8" and larger mains). Do not project branch pipes inside main pipe.

L. Accessibility:

a. Install fire protection work to permit removal (without damage to other parts) of coils, heat exchangers, pumps, fan shafts and wheels, belt guards, sleeves and drives, and other parts requiring periodic replacement and/or maintenance.

b. Arrange pipes and equipment to permit ready access to valves, cocks, traps, starters, motors, dampers, control components, and to clear openings of swinging and overhead doors and of access panels.

c. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

M. Flanged joint shall be made with 1/16" rubber gaskets and square head machine bolts with heavy finished hexagon-head nuts having dimensions conforming to American Standard B-18-2.

N. Pipe shall be hung from building members using approved hangers. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building. Hang pipes from structure only. Do not hang piping from ceiling assembly, adjacent equipment, other pipes, or ductwork. Provide additional structural steel support as required.

O. Install piping so that system can be drained in accordance with NFPA 13. Where possible, slope to main drain valve. Slope dry pipe and preaction systems subject to freezing at minimum ¼-inch per 10-feet on mains and ½-inch per 10-feet on branches. Where piping not susceptible to freezing cannot be fully drained, install ¾" hose nipple and cap for drainage of less than 5 gallons or ball valve with hose thread outlet and cap for drainage over 5 gallons. Pipe main drain valve to grade or to air gap sewer receptor.

P. When necessary to install a "U"-shaped dip in a pipe due to a conflict with ductwork or other building components, Contractor shall install a ¾" diameter hose nipple and cap for drainage of less than 5 gallons or ball valve with hose thread outlet and cap for drainage over 5 gallons. Contractor shall try to arrange piping layout to avoid such dips. No such dip shall be installed

without prior approval of the Engineer. All such conditions shall be clearly indicated and noted on the record drawings given to the Owner upon completion.

Q. When necessary to install an inverted "U" in the branch piping to rise above an obstruction, Contractor shall install an upright ¾" diameter air vent nipple and cap at high point of inverted "U". Contractor shall try to arrange piping layout to avoid such high points. No such installation shall be made without prior approval of the Engineer. All such conditions shall be clearly indicated and noted on the record drawings given to the Owner upon completion.

R. Mitered ells, notched tees, and orange peel reducers are not acceptable. Bushings and reducing couplings are not acceptable.

S. Do not route piping within exterior walls.

T. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

3.04. SERVICE ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Install underground piping with restraint joints at horizontal and vertical changes in direction. Use restraint-joint piping, thrust blocks, anchors, tie-rods and clamps and other supports. Comply with requirements for exterior piping, NFPA-13, Standard for the Installation of Sprinkler Systems and NFPA-24, Installation of Private Fire Mains and Their Appurtenances to include the requirements for seismic separation at entrances through slabs and floors.

3.05. WELDED PIPE JOINTS

B. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (½) the diameter of the main.

C. All welding shall be performed by experienced welders in a neat and workmanlike manner. Welding done on piping, pressure vessels and structural steel under this section shall be performed only by persons who are currently qualified in accordance with ANSI Standard Code for Pressure Piping, Section I, Power Piping, Bulletin ANSI B31.1.0-1980; applicable portions of ASME Boiler and Pressure Vessel Code, Section I, Power Boilers, and Section IX, Welding Qualifications.

D. Submit for approval and record certified copies of Procedure Specification for Welding, Welding Procedure Qualification Tests and Welder Performance Qualification Tests. Welding specifications and qualification tests shall be recorded on Forms Q-1, as recommended in Appendix II of Section IX of the ASME Boiler and Pressure Vessel Code. Records shall be certified by Contractor and shall be accessible to authorized inspector.

E. Bevel piping on both ends before welding as required and defined in Code.

F. Use following weld spacing on all butt-welds:

Pipe Wall Thickness	Space
¼″ or less	1/8″
Over ¼″ or less than ¾″	3/16″
¾″ and over	3/16″

G. Use backing rings on welds in all piping 3-inches and larger.

H. Before start of any welding, remove all corrosion and other foreign material from surface to be welded.

I. Welding shall be performed by either manual shielded metallic arc process or automatic submerged arc process. Use direct current exclusively.

J. Electrodes to be used with manual shielded metallic arc method shall conform to ASTM A-233, Classification E-6010.

K. Size of electrodes, voltages, current, thickness and number of passes or beads shall be in accordance with provisions of previous paragraph.

L. After deposition, clean each layer of weld metal to remove all slab and scale by wire brushing or grinding, then chip where necessary to prepare for proper deposition of next layer.

M. Weld reinforcement shall be not less than $\frac{1}{16}$″ nor more than ⅛″ above normal surface of joined sections. Reinforcement shall be crowned at center and shall taper on each side to surface being joined. Exposed surface of weld shall present workmanlike appearance and shall be free of depressions below surface of joined members.

N. No welding of any kind shall be done when temperature of base metal is lower than 0 degrees F. Material to be welded during freezing temperatures shall be made warm and dry before welding is started. Temperature of metal shall be "warm to hand" -- or approximately 60 degrees F.

N. All welders engaged in work performed under this Section shall have been qualified in accordance with test requirements of Section IX of the ASME Boiler and Pressure Vessel Code. Each operator shall identify his production welds by marking his regularly assigned identification number or mark within 1″ of weld. Contractor shall submit to Architect / Engineer complete list of individual numbers of identifying marks and operator's name. Copy of each operator's certificate shall be filed with Architect / Engineer.

O. Welds will be inspected visually by representatives of Architect / Engineer and Contractor. Any weld judged defective by Architect / Engineer from visual inspection shall be cut out and tested in presence of or his representative. In event any welder consistently produces high percentage of unsatisfactory production welds, he shall be discharged at request of Owner even though he is able to produce satisfactory welds when test expected in advance. Removal and replacement of test coupons and samplings shall be done at expense of Contractor.

3.06. THREADED PIPE JOINTS

A. Die cut screw joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

B. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.07. MECHANICAL GROOVED PIPE CONNECTIONS

A. Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in accordance with the same specifications using specially designed tools for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications.

3.08. MECHANICALLY FORMED TEE FITTINGS

A. Form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. Use an adjustable collaring device. Notch and dimple the branch tube. Braze the joint with neutral flame oxy-acetylene torch, applying heat properly so that pipe and tee do not distort; remove distorted connections.

3.09. UNIONS AND FLANGES

A. Install a union or flanges at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.10. CLEANING

A. Flush entire piping system of foreign matter in accordance with NFPA 13.

3.11. PIPING SYSTEM LEAK TESTS

A. Conduct pressure test with test medium of water.

B. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Entire test shall be witnessed by the Architect / Engineer and any authorities having jurisdiction who may so require.

C. After completing branch system, Contractor shall test fire sprinkler piping hydrostatically for a period of two hours at not less than 200 psi or at 50 psi in excess of the maximum operating static pressure when the maximum static pressure exceeds 150 psi. Contractor shall check system for

leakage of joints and measure hydrostatic pressure at low point of each system or zone being tested.

D. As specified in NFPA-13 for dry and preaction systems, an air pressure leakage test at 40 psi shall be conducted for 24 hours. There shall be no drop in pressure in excess of 1.5 psi for 24 hours. The air pressure test is in addition to the required hydrostatic test.

E. The Contractor shall repair or replace piping and fittings as required to eliminate leakage (in accordance with ANSI/NFPA standards for "little or no leakage") and retest as specified to demonstrate compliance.

F. Upon satisfactory completion and testing of branch piping system, Contractor shall provide Owner with a letter certifying that branch piping system has been completed in accordance with ANSI/NFPA 13 and is operational, complete and has no defects.

G. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.

H. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

I. All pressure tests are to be documented on NFPA Contractor's Material and Test Certificate forms.

END OF SECTION 15060C

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SECTION 15140C

FIRE SUPPRESSION HANGERS AND SUPPORTS

1. PART 1 – GENERAL

1.01. SCOPE

A. This section includes specifications for supports of all fire protection equipment and materials as well as piping system anchors.

1.02. REFERENCE

A. Drawings and general provisions of the contract, including General and Supplementary Conditions, and the applicable provisions of Division 1, govern work under this section.

1.03. RELATED WORK

A. The following technical fire suppression specifications sections are directly related to the provisions of this section.

Section 15060C – Fire Suppression Pipe and Fittings
Section 15300C – Water-Based Fire Suppression Systems
Section 15320C – Fire Pumps

1.04. REFERENCE STANDARDS

A. Specific standards referenced in this section are as follows:

MSS SP-58	General Standard
MSS SP-69	General Standard
NFPA 13	Installation of Sprinkler Systems (Latest prevailing addition).
NFPA 14	Installation of Standpipe and Hose Systems (Latest prevailing addition).
UL	Underwriter's Laboratories Listed.
FM	Factory Mutual Approved

1.05. QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, "Equals and Substitutions".

1.06. DESCRIPTION

A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for building piping, and shall be UL-listed.

B. Do not hang any mechanical item directly from a metal deck, or run piping so it rests on the bottom chord of any truss or joist.

C. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.

D. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

E. Follow manufacturer's requirements for installation with wood construction.

F. Refer to NFPA 13 for acceptable support assemblies.

1.07. SHOP DRAWINGS

A. Schedule of all hanger and support devices indicating shields, attachment methods, and type of device for each pipe size and type of service. Provide details on the working drawings submitted for approval with all pertinent information listed.

1.08. DESIGN CRITERIA

A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58. Select and apply pipe hangers and supports complying with MSS SP-69. Fabricate and install pipe hangers and supports, comply with MSS SP-89. Terminology used in this section is defined in MSS SP-90.

B. Piping connected to pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the one hundred pipe diameter / three support distance.

C. Materials and application of pipe hangers and supports shall be in accordance with NFPA ruling and be UL/FM listed and approved

2. PART 2 – PRODUCTS

2.01. MANUFACTURERS

A. B-Line, Anvil, Pate, Piping Technology, Roof Products & Systems, Unistrut, or approved equal.

2.02. STRUCTURAL SUPPORTS

A. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the drawings.

2.03. PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes ½-Inch through 2-Inches: Carbon steel, adjustable swivel ring with 3/8-inch minimum UL/FM approved hanger rods. B-Line B3170NF, Anvil 69 or 70. Carbon steel, adjustable clevis, standard, with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.

B. Hangers for Pipe Sizes larger than 2-inches through 8-inches: Carbon steel, adjustable swivel ring with ½-inch minimum UL/FM approved hanger rods. B-Line B3170NF, Anvil 69 or 70. Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.

C. Multiple or Trapeze Hangers: Manufactured steel channel system with manufacturers slotted interlocking pipe clamps with screw/nut securing and treaded hanger rods or steel channels with welded spacers and threaded hanger rods.

D. For trapeze hangers, the minimum size of steel angle or pipe span between purlins or joists shall be as shown in NFPA 13.

E. Location of hangers shall conform to NFPA 13, except that no mains, parallel to joists shall be supported from a single joist. Mains parallel to joists shall be supported from a trapeze hanger and be positioned equally between two or more joists. The trapeze hangers shall be positioned to load the joists at the panel points only. Verify all weights and loading with structural engineer.

F. Wall Support: Carbon steel welded bracket with hanger. B-Line 3060 Series, Anvil 190 Series. Perforated epoxy painted finish, 12-gauge minimum, steel channels securely anchored to wall structure, with interlocking, split-type, bolt secured, galvanized pipe/tubing clamps. B-Line Type "S" Channel with B-2000 Series clamps, Anvil Type "PS" 200 H with "PS" 1200 clamps.

G. Vertical Support: Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use. Grinnell 40 with bolts and concrete anchors for attachment to underside of concrete floor deck.

H. Floor Support: Painted carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T or B3093.

2.04. PIPE HANGER RODS

2.04.1. STEEL HANGER RODS

A. Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.

B. Size rods for individual hangers and trapeze support as indicated in the following schedule.

Pipe Size	*Rod Diameter (Inches)*
Up to and Including 2"	3/8" or 9.5mm min.
3" thru 8"	1/2" or 12.7mm min.

2.05. BEAM CLAMPS

A. MSS SP-69 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8, ½, and 5/8-inch diameter. Furnish with a hardened steel cup point set screw. B-Line B3036L/B3034, Anvil 86/92.

B. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1 ½-inch diameter. B-Line 3054, Anvil 228.

C. Simplex top beam clamps shall be used in lieu of C-clamps when hanging 3-inch and larger pipe from the top chord of joists to provide even distribution of weight over both angles of the top chord.

2.06. CONCRETE INSERTS

2.06.1. POURED IN PLACE

A. MSS SP-69 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rods to 7/8-inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. B-Line B2505, Anvil 281.

B. MSS SP-69 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rods to 7/8-inch diameter. B-Line B3014N, Anvil 281.

2.06.2. DRILLED FASTENERS

A. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead, or approved equal.

2.07. ANCHORS

A. Use welding steel shapes, plates, and bars to secure piping to the structure.

2.08. EQUIPMENT STANDS

A. Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, threat with corrosive atmosphere coatings.

2.09. CORROSIVE ATOMOPHERE COATINGS

A. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface each side. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.

B. Corrosive atmospheres include the following locations:

- Exterior Locations
- Chemical Storage Rooms (Janitor's Storage / Supplies)
- Mechanical and Pump Rooms
- Kitchens
- Locker Rooms
- Loading Docks

3. PART 3 – EXECUTION

3.01. INSTALLATION

A. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

B. Verify location of all sprinkler mains with structural engineer to ensure adequate structural capacity.

C. Size, apply and install supports and anchors in compliance with manufacturers' recommendations.

D. Coordinate hanger and support installation to properly group piping of all trades.

E. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices, provided that similar types are used and all data is submitted for prior approval.

F. Perform welding in accordance with standards of American Welding Society.

3.02. HANGER AND SUPPORT SPACING

A. Install hangers to provide minimum ½-inch space between finished covering and adjacent work.

B. Place a hanger within 12-inches of each elbow, valve, strainer, or similar piping specialty item.

C. Use hangers with 1 ½-inch minimum vertical adjustment.

D. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

E. Support riser piping independently of connected horizontal piping.

F. Adjust hangers to obtain the slope specified in the piping section of these specifications.

G. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Maximum Horiz. Spacing	Maximum Vert. Spacing
Steel	1-inch thru 1 ¼-inch	10′-0″	10′-0″
Steel	1 ½-inch thru 4-inch	12′-0″	15′-0″
Steel	4-inch thru 8-inch	15′-0″	15′-0″

Unsupported length from the last hanger and an end sprinkler shall be as follows:

1-inch piping	Not greater than 24″
1 ¼-inch piping	Not greater than 36″
1 ½-inch piping or larger	Not greater than 48″

3.03. RISER CLAMPS

A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor. Use method of securing the vertical risers to the building structure below in stairwell locations.

3.04. CONCRETE INSERTS AND CONTINUOUS INSERT CHANNELS

A. Select size based on the manufacturer's stated load capacity and weight of material that will be supported. Locate continuous insert channels on 6-foot, 0-inch (6′-0″) maximum centers and 2-foot, 0-inches (2′-0″) from corners. Furnish inserts to the General Contractor for placement in concrete formwork. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4-inch size. Where concrete slabs form finished ceilings, provide inserts that are flush with the slab surface.

B. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with the slab.

3.05. ANCHORS

A. Install anchors where indicated on the drawings and details, as required for proper pipe support, and in accordance with manufacturer's recommendations, associated standards, applicable codes, and prudent engineering practice. Install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops.

B. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.06. HANGER AND SUPPORT SPACING

A. Secure bottom of support flat on roof deck. Apply two coats of zinc rich paint to cut edges of all galvanized steel elements. Flashing and counterflashing by the General Contractor.

END OF SECTION 15140C

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SECTION 15300C

WATER-BASED FIRE SUPPRESSION SYSTEMS

1. PART 1 – GENERAL

1.01. SUMMARY

A. Work Included: There are a minimum of seven automatic fire sprinkler zones scheduled and outlined on the drawings. Each system will connect to an 8-inch water service with fire pump. Each zone begins with a zone control valve with tamper switch, flow switch (on wet systems only), inspectors' test valve, and auxiliary drain valve.

B. Provide complete fire protection systems including all necessary piping, valves, controls, fittings and hardware for each of the following buildings and the corresponding system types:

Building	***Automatic Fire Sprinkler Zone***
Offices, Basement, and Mechanical Rooms	Wet Pipe System
Evidence Storage Rooms	Preaction System

C. The system will include standard components including but not limited to the preaction valve and trim, compressed air maintenance systems and components, control valve with tamper switch, pressure switch to alarm, inspector's test valve, and auxiliary drain valve.

D. Work under this section shall commence with a connection to the potable water service and all interior fire protection systems. Fire Protection Contractor shall provide and install the connection of an approved control valve assembly and an approved double check valve assembly from a tee in the potable water service located in the Pump Room #100.

E. Fire Protection Contractor shall install all necessary piping, accessories and appurtenances required for complete sprinkler system installation and may install additional piping, fittings and valves for testing purposes or for the convenience of the installation. Where such materials are installed, they shall comply with the specifications and shall be sized to be compatible with the system design requirements.

F. Where installed materials interfere with the design conditions they shall be removed and relocated as required or as directed by the Architect/Engineer.

G. The Fire Protection Contractor shall be responsible for designing the complete sprinkler system in accordance with all applicable NFPA standards, state and local codes, as well as any additional criteria set forth in these specifications. The installing contractor shall be the official Engineer-of-Record for this project.

H. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for exact dimensions. Where architectural features govern location of work, refer to architectural drawings. Check, verify, and coordinate work with drawings and specifications prepared for other trades. Include all modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.

I. Provide complete installation drawings. The fire protection system design shall be coordinated with drawings and specifications prepared for or by other trades. Include all modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades. Installation details shall be furnished for standard components and where coordination of work or particular design conditions necessitates.

J. Concealed Spaces: Contractor shall be responsible for complying with all applicable requirements of NFPA 13 regarding sprinkler coverage of concealed spaces, including, but not limited to, the plenum spaces above the ceiling. If sprinklers are not required, Contractor shall verify which NFPA exception applies and obtain written approval / verification from the authority having jurisdiction.

K. Related Sections and Divisions: The work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and the applicable provisions of Division 1 shall govern work in this section.

1.02. RELATED DOCUMENTS

A. Scope drawings and general provisions of the contract, including General and Supplementary Conditions, and the applicable provisions of Division 1, govern work under this section.

B. The General Conditions, Special Conditions, Supplementary Conditions, Plumbing Specifications of the Main Specifications, and the "General Conditions of the Contract", current edition, published in standard form the American Institute of Architects, shall apply to all work on this project, except as modified by this specification. The Contractor shall familiarize himself with their provisions and shall adhere to their requirements.

C. Additional specification sections of Division 15300C, including (but not limited to):

Section 15000C – Common Work Results for Fire Suppression
Section 15140C – Fire Suppression Hangers and Supports
Section 15060C – Fire Suppression Piping and Fittings
Section 15320C – Fire Pumps

1.03. CODES AND STANDARDS

A. The work shall conform to all provisions of the Wisconsin Administrative Code, applicable NFPA standards, International Building Codes (including the IFC), and applicable OSHA Regulations, together with all local codes and regulations in force at the time of execution of the contract.

B. The work shall conform to all provisions and requirements of the City of Milwaukee, including all local inspectors, the Local Fire Chief, authority having jurisdiction (AHJ), the planning commission, and all other governing local bodies.

C. Obtain and pay for all permits or licenses required under this contract, including all state and local required installation inspections and all applicable utility company charges. Deliver originals of these certificates to the Owner / Architect. Include copies of certificates, permits and payments of the same to the Owner, and provide a separate set of copies in the Operating and Maintenance Manual.

D. All fire protection work shall conform to all applicable local, state, and federal codes, along with NFPA standards, local requirements of the Fire Chief, and all applicable provisions and requirements of the insurance underwriter. Applicable codes and standards include, but are not limited to, the following:

1. ASSE 1015: Double Check Valve Backflow Preventers
2. NFPA 13: Installation of Sprinkler Systems
3. NFPA 14: Installation of Standpipe and Hose Systems
4. NFPA 20: Installation of Stationary Fire Pumps
5. NFPA 24: Installation of Private Fire Service Mains and Their Appurtenances
6. NFPA 25: Inspection, Testing & Maintenance of Water-Based Fire Protection Systems
7. NFPA 72: National Fire Alarm Code
8. Underwriters Laboratories Fire Protection Equipment Directory
9. Current Factory Mutual Approval Guide
10. Local and State Building, Mechanical and Fire Codes

1.04. REFERENCE STANDARDS

A. Specific standards referenced in this section are as follows:

ANSI A21.4	General Standard
ANSI A21.11	General Standard
ANSI A21.51	General Standard
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI B16.3	Malleable Iron Threaded Fittings
ANSI B16.4	Cast Iron Threaded Fittings
ANSI B16.5	Pipe Flanged and Flanged Fittings
ANSI B16.9	Factory Made Wrought Steel Buttweld Fittings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM A105	Forgings, Carbon Steel, for Piping Components
ASTM A126	Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A135	Electric Resistance Welded Steel Pipe
ASTM A181	Forgings, Carbon Steel for General Purpose Piping
ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A536	Ductile Iron Castings

ASTM A795	Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASW D10.9	Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR3
NFPA 13	Installation of Sprinkler Systems. (Latest prevailing addition)
NFPA 14	Installation of Standpipe and Hose Systems. (Latest prevailing addition)
UL	Underwriters' Laboratories Listing
FM	Factory Mutual Approval

1.05. QUALITY ASSURANCE

A. Planning, calculations, layout, and installation shall be performed by licensed persons employed by the sprinkler contractor. A certified Sprinkler Designer or licensed Professional Engineer for planning and calculations, and journeyman sprinkler fitters for installation foreman and supervisory personnel.

B. The field installation shall be constantly supervised by competent, experienced journeyman fitter(s). The Supervisor shall be in charge of the installation of the work together with all Subcontractors, skilled workmen, and their laborers. The Supervisor shall be responsible for the work so that it is properly coordinated and supervised to the satisfaction of the Architect / Engineer.

C. The Contractor shall be licensed by the State of Wisconsin for installation of sprinkler fire protection systems.

D. The Contractor(s) shall submit pre-qualification evidence of at least 5 projects of comparable size and scope successfully completed with their bid. Distortion or misrepresentation of qualification evidence may result in contract cessation.

E. Examination of Plans, Specifications, and Existing Conditions: Before submitting a bid, the Contractor shall familiarize himself with all existing conditions at the site. If, in the opinion of the Contractor, there are omissions or errors in the plans or specifications, the Fire Protection Contractor shall clarify these points with the Architect / Engineer before submitting his bid.

F. Throughout the course of work, minor changes and adjustments to the Plans and Specifications may be required by the Owner. The Contractor shall make such adjustments without additional cost to the Owner, where adjustments are necessary to the proper installation and operation and within the intent of the Contract Documents. Fire protection work shall include all labor, material, and equipment necessary to provide a complete and operating fire protection system.

G. The complete set of bid documents is the basis of this project. The Contractor shall familiarize himself with all aspects of the project, including the complete set of drawings and specifications. Valuable information can be attained from other disciplines, including obstructions, areas of specific coordination, additional equipment, etc. All drawings are incorporated into the contract.

H. Owner reserves the right to reject workmanship or material not in conformance with plans and specifications before or after installation. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

I. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, "Equals and Substitutions".

J. Order all copper and steel pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.

1.06. DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion and deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.07. DESIGN CRITERIA

A. Available water supply data (for bidding purposes only) is as follows. Information supplied by City of Milwaukee – Water Works Department.

1. Date of Test: July 21, 2008
2. Flow Hydrants
    a. E/S OF N 27TH ST,1ST HYDRANT S/O W WISCONSIN AVE
    b. SWC OF W WISCONSIN AVE & N 26TH ST
3. Residual Hydrant
    a. NEC OF W WISCONSIN AVE & N 27TH ST
4. 71 psi static.
5. 67 psi residual.
6. 3,860 GPM.

B. **Fire Protection Contractor shall perform flow tests 90 days prior to the preparation of design calculations.** Test shall be representative of high water use periods. Submit a copy of the flow test data to the Owner, Architect, and Engineer for their records.

a. Design fire protection systems in accordance with codes, standards and regulations noted above. Design sprinkler systems for the most hydraulically remote area based on the

following:

Occupancy Classification	***Most Remote (SF)***	***(GPM/SF)***	***Hose Streams***	***Temp.***
Light Hazard	1,500	0.10	100 gpm	165° F.
Ordinary Hazard, Group 2	1,500	0.20	250 gpm	165° F.
Extra Hazard, Group 2	1,500	0.40	500 gpm	265° F.

Note that the above data has been provided for typical areas. Contractor shall refer to the construction documents for additional data and shall properly design the system per NFPA 13 requirements. Design multipliers have not been applied for use of quick response sprinklers, small room design, dry pipe or preaction systems, head temperature, etc. Intermediate and high temperature sprinkler heads shall be provided where required by code.

b. Maximum head spacing per NFPA 13, for each occupancy hazard indicated.

c. Hydraulic Calculations: Sprinkler systems which shall be hydraulically designed must be designed a minimum of 10 percent below the highest estimated available water supply curve.

d. Hose Streams: Add indicated hose streams to all sprinkler zone hydraulic calculations, at the base of the riser.

e. Water velocity throughout the entire system shall not exceed 20 feet per second.

f. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

g. Construct all piping systems for the highest pressures and temperatures in the respective system but not less than 175 psig.

h. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having centerline radius of 1.5 pipe diameters.

i. Where ASTM A53 or A795 Type F pipe is specified, Grade A, Type E or S, or Grade B, Type E or S may be substituted at Contractor's option. Where ASTM A135 Grade A pipe is specified, Grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

1.08. WELDER QUALIFICATIONS

A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified welding procedures on the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is

performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.

B. The Architect or Engineer reserves the right to test the work of any welder employed on the project. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

2. PART 2 – PRODUCTS

2.01. QUALITY ASSURANCE

A. UL & FM Compliance: Unless otherwise indicated, all products shall be listed in the latest publication of Approval Guides for Underwriters Laboratory and Factory Mutual for the service intended. All system components shall be in conformance with applicable NFPA Standards.

B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

2.02. SPRINKLER HEADS

A. Manufacturer: Sprinkler head model numbers establish type and style of head. Products of the following manufacturers determined to be equal by the Architect/Engineer will be accepted: Tyco, Reliable Automatic Sprinkler Co., Viking Corporation, and Victaulic.

B. All sprinkler heads shall be UL listed and FM approved, fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal ½-inch discharge orifice except where greater than normal density requires large orifice.

C. Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating allowed under normal conditions at installed location and as indicated. Provide the following sprinkler heads for the appropriate location:

1. Ordinary Temperature (165° F): Fusible link or glass bulb type except at skylights, sealed display windows, unventilated attics and roof spaces, over cooking equipment, adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, mechanical rooms, storage rooms, or where otherwise indicated.
2. Intermediate Temperature (212° F): Fusible link or glass bulb type.
3. High Temperature (265° F): Fusible link or glass bulb type.

D. Listed corrosion-resistant sprinkler heads shall be installed in locations where chemicals, moisture, or other corrosive vapors sufficient to cause corrosion of such devices exist. Sprinkler heads located in the exterior overhangs, mechanical rooms, janitor's storage / supplies, shower rooms, kitchens, and all other exterior areas shall be listed corrosion-resistant heads.

E. Sprinkler Cabinets: Provide cabinets complete with required number of spare heads of each

type and temperature rating and special wrenches in accordance with NFPA 13. Provide multiple cabinets as required. Cabinet shall be finished steel, suitable for wall mounting, with hinged cover and adequate space for required spare heads and wrenches. Coordinate cabinet location with Owner's Representative. Provide 6 spare heads per 300 or less installed heads, 12 per 1,000 or less installed heads, and 24 for more than 1,000 installed heads.

F. Sprinkler type and finish for each application shall be as follows (or approved equal):

1. Pendent: Viking Microfast "M", chrome plated finish and escutcheon.
2. Extended Coverage Pendent: Viking Microfast "EC/QREC", chrome plated finish and escutcheon.
3. Sidewall: Viking Microfast "M" HSW, chrome plated finish and escutcheon.
4. Upright: Viking Microfast "M", brass finish.
5. Extended Coverage Upright: Viking Microfast "EC/QREC", brass finish.

** All sprinkler head selections shall be approved by Owner/Engineer prior to installation.

Brass sprinkler heads are to be utilized where sprinkler heads are installed on exposed piping.

Additional sprinkler heads may be required based upon application. Contractor shall verify and furnish and install as required.

Provide Viking Model D-1 sprinkler guards at locations indicated on the floor plan.

2.03. SUPERVISORY / TAMPER SWITCHES

A. Tamper switches shall be UL listed and FM approved, capable or transmitting a signal with only ¼ -inch turn of the valve operator. Unit shall be compatible with the fire alarm system.

B. For OS&Y valve or butterfly valve installations, to monitor position of valve, tamper reistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use, NEMA 4 and 6P enclosures.

2.04. FLOW SWITCHES

A. Flow switches shall be UL listed and FM approved, capable of transmitting a signal when the flow of water equals or exceeds the discharge of a single head. Unit shall be vane type, with metal enclosure, adjustable pneumatic retard chamber and electrical characteristics compatible with fire alarm system.

2.05. PRESSURE SWITCHES

A. Pressure actuated switches shall be UL listed and FM approved, capable of transmitting a signal when the pressure drops due to loss of air in the system with field adjustable settings, metal enclosure and electrical characteristics compatible with fire alarm system.

2.06. PRESSURE GAUGES

A. Manufacturers: Ametek / U.S. Gauge Division, Ashcroft, Marsh, Taylor, H.O. Trerice, Weiss, Weksler.

B. Pressure gauges shall be UL listed and FM approved. Cast aluminum, stainless steel or brass case of not less than 3.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze Bourbon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale. Include bronze 3-way globe valve with plugged outlet for Fire Inspector's test gauge.

2.07. LOCAL ALARM BELL OR HORN/STROBE

A. Fire Protection Contractor shall verify with the location and type of exterior notification device with the local fire department. Locate notification device above (or in line with) the fire department connection.

B. Weatherproof electric alarm bell with red painted metal housing, mounting base and gong, solenoid operator, weatherproofing O-ring seal and electrical characteristics compatible with alarm system.

C. Weatherproof horn/strobe with red housing, capable of producing 115 candela, mounted on a weatherproof junction box. Horn/strobe shall have signage or bezel indicating automatic sprinkler system operation.

2.08. GATE VALVES

A. Manufacturers: Kennedy, Milwaukee, Mueller, Nibco, Stockham, and Viking.

B. UL listed/FM approved, outside screw and yoke (OS&Y) gate valves, 300 psi test and 175 psi non-shock cold water working pressure, cast iron body, bronze mounted, bolted bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads. Valves shall be capable of being repacked under pressure, with valve wide open. Equal to Nibco F-607-O.

2.09. BALL VALVES

A. Manufacturers: Kennedy, Milwaukee, Mueller, Nibco, Stockham, and Viking.

B. UL listed/FM approved, bronze, 2-piece, threaded or sweat ends, standard port, blowout proof stem, chrome plated ball, glass reinforced seats, UL approved @ 250 psi. Valves shall be equal to Nibco KT-580 or Watts No. B-6000 UL.

2.10. BUTTERFLY VALVES

A. Manufacturers: Kennedy, Milwaukee, Mueller, Nibco, Watts.

B. Two-inches and Smaller: Bronze body butterfly valve, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, Buna or Viton seat, stainless steel disc and stem. Equal to Milwaukee Model BB-SC01.

C. Two-inches and Larger: Cast or ductile iron body butterfly valve, lug style, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, EPDM resilient seat, EPDM seals, nickel plated ductile iron disc. Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use cap screws for removal of downstream piping while using the valve for system shutoff. Equal to Nibco LD3510-2.

2.11. TEST AND DRAIN VALVES

A. Threaded bronze globe type with composition disc, 175 psi WOG. Valves shall be equal to Nibco KT-65 for piping assemblies built on site. Victaulic style 718 or 719 or equal may be installed to save space and assembly time.

2.12. DRAIN VALVES

A. UL listed, 1-inch minimum, two or three piece bronze body ball valve; threaded ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG. Low point drain valves shall have, in addition, a 1-inch brass nipple with ¾ -inch male hose threads and cap.

2.13. CHECK VALVES

A. Manufacturers: Kennedy, Mueller, Nibco, Viking.

B. Cast or ductile iron body, renewable bronze seat and disc, stainless steel clapper with a replaceable rubber seal (a rubber seal integral with the seat is not acceptable), 350 psi test and 175 psi non-shock cold water working pressure, suitable for installation in a horizontal or vertical line with flow upward. Valve equal to Viking Model D.

C. Provide ½" automatic drip drain on inlet of fire department connection check valve.

2.14. SPRING LOADED CHECK VALVES

A. Manufacturers: Kennedy, Mueller, Nibco, Viking.

B. 2-Inches and Smaller: Bronze body, threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, 175 psig, Teflon seat unless only bronze available.

C. 2 ½-Inches and Larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, 175 psig.

2.15. DOUBLE CHECK VALVE ASSEMBLY

A. Manufacturers: Ames, Beeco, Cla-Val, Conbraco, Febco, Watts, and Wilkinson.

B. ASSE 1015 double check backflow preventer with two independent spring loaded check valves, two isolation ball or gate valves with normally open tamper switches with double wire leads, 4-valved test ports. Size for a maximum pressure drop of 10 psi at design flow

rate. Constructed of bronze or epoxy coated cast iron or stainless steel body with bronze and plastic internal parts, stainless steel springs, silicone rubber valve discs, bronze seats, rated for 175 psig. Valve assembly equal to 6-inch.

2.16. SPECIALTY VALVES

A. Manufacturers: Reliable, Tyco, Victaulic, and Viking.

2.16.1. ALARM VALVE AND ACCESSORIES

A. The wet-pipe sprinkler system control valve installation shall be an FM approved assembly and not separately approved components.

B. Each system shall include, but not be limited to, the following components:

1. Tyco Model F or G Alarm Valve or equal with divided seat ring, rubber-faced clapper, check type.
2. Standard valve trim.
3. Supply control valve with Tamper Switch compatible with the building Fire Alarm System.
4. Main Drain.
5. Retard Chamber.
6. Adjustable Flow Switch compatible with the building Fire Alarm System.
7. Pressure Gauges each side of Alarm Valve.

C. Alarm Check Valve: Cast or ductile iron body, flanged or grooved ends, 175 psig, bronze grooved seat with O-ring seal, single hitch pin and latch design. Provide trim for bypass, drain, electric sprinkler alarm switch, pressure gauges, precision retarding chamber, drip cup assembly piped to floor or hub drain, fill line attachment with strainer.

2.16.2. PREACTION VALVE CABINET (BASE BID)

A. The preaction sprinkler system control valve installation shall be an FM approved assembly and not separately approved components. The system shall be configured as a single interlock design.

B. Each system shall one Red-E-Cabinet which includes, but not be limited to, the following components:

1. Tyco DV-5 Preaction Valve and trim.
2. Preaction Control Panel: Single area cross zoned type in NEMA 1 enclosure with detector, alarm, power supply, battery charger, standby battery, electrically supervised solenoid valves, polarized fire alarm, lamp test, wiring terminal strip, auxiliary alarm contacts.
3. Check Valve.
4. Alarm pressure switch.
5. Supply control valve with Tamper switch.
6. Tyco AMD-2 Air Maintenance Device, Compressor Control Type or equal.
7. Maintenance air compressor.

8. Main Drain.
9. Pressure Gauges each side of Alarm Valve.

2.16.3. PREACTION VALVE (ALTERNATE BID)

A. The preaction sprinkler system control valve installation shall be an FM approved assembly and not separately approved components. The system shall be configured as a single interlock design.

B. Deluge/Preaction Valve: Cast or ductile iron body, flanged or grooved ends, 175 psig, bronze grooved seat with o-ring seal. Provide trim for bypass, drain, electric sprinkler alarm switch, pressure gages, drip cup assembly piped to floor or hub drain, fill line attachment with strainer and push rod chamber assembly. Include dry pilot trim consisting of actuator, air and water pressure gages, low air warning switch, air relief valve and diaphragm actuation device with replaceable bronze seat and resilient diaphragm.

C. Deluge/Preaction Control: Single area cross zoned type in NEMA 1 enclosure with detector, alarm, power supply, battery charger, standby battery, electrically supervised solenoid valves, polarized fire alarm, lamp test, wiring terminal strip, auxiliary alarm contacts.

C. Each system shall include, but not be limited to, the following components:

1. Tyco DPV-5 Preaction Valve or equal.
2. Preaction valve trim.
3. Check Valve.
4. Alarm pressure switch compatible with the building Fire Alarm System.
5. Supply control valve with Tamper switch compatible with the building Fire Alarm System.
6. Tyco AMD-2 Air Maintenance Device, Compressor Control Type or equal.
7. Maintenance air compressor.
8. Main Drain.
9. Pressure Gauges each side of Alarm Valve.

2.16.4. AIR PRESSURE MAINTENANCE DEVICE

A. Automatic air maintenance control capable of maintaining system air pressure, rated for 175 psig, adjustable air pressure range of 15 to 60 psig, complete with isolation valves, bypass fill valve, pressure regulator or pressure switch and strainer.

2.16.5. EMERGENCY PULL BOX

A. ½" ball valve in metal enclosure with ½" pipe nipple, "Manual Emergency Station" label and breakaway door.

2.17. AIR COMPRESSOR

A. Manufacturers: Quincy, Ingersoll Rand, Nash, and Viking.

B. Single zone and small systems: Riser pipe mounted air compressor installation. Electric motor driven, air cooled, oil-less, adjustable, single stage compressor. With check valve,

pressure switch, pressure relief valve, mounting bracket kit and air filter assembly. Equal to Viking model E-1.

2.18. HOSE OUTLET VALVES

A. Manufacturer: Badger-Powhatan, Croker, Elkhart Brass, Potter-Roemer, or Guardian.

B. Class I and Class III Systems: 2-1/2" (chrome plated) brass angle valve, 300 psig, with removable red handwheel, 2-1/2"x1-1/2" reducing lug pin connector coupling and National Standard male hose thread outlet, cap and chain. Provide N.P.T. female outlet where hose is required.

2.19. FIRE PUMP TEST CONNECTION

A. Manufacturer: Badger-Powhatan, Croker, Elkhart Brass, J.W. Moon, Potter-Roemer, and W.D. ALLEN

B. Free-standing, cast brass fire pump test connection outlet, four-way outlet body, male snoots, pin-lug caps with chains, removable swivel hose gate valves with 2-1/2" National Standard male hose thread outlets, 6" inlet, cast brass lettered identification.

2.20. FIRE DEPARTMENT CONNECTION

A. Manufacturers: All equipment shall be UL listed and FM approved by Elkhart Brass, Potter-Roemer, Badger-Powhatan, Metal Cabinet Company, Fire End and Croker Corp., and American Fire Hose Cabinet Co., equal to product listed.

B. Fire Department Pumper Connection: Pumper connection shall be yard mounted type, cast brass body with drop clappers, polished chrome cover plate with lettering reading “AUTO SPRINKLER”. Unit shall include three 2-1/2-inch chrome plated brass snoots with rigid end threading to match local fire department standards by pin-lug hose thread swivels, pin-lug plugs and chains.

C. Ball Drip: Provide a bronze ball drip for the fire department connection inside of the building and pipe to the nearest floor drain.

3. PART 3 – EXECUTION

3.01. GENERAL INSTALLATION

A. Install pipe, fittings, equipment and components in accordance with referenced standards, manufacturers’ recommendations, recognized industry practices, and the authority having jurisdiction.

B. General Coordination: Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings

for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures and grilles before installing piping.

C. Where piping must be embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.

D. Maintain piping, fittings, and fire protection system components in clean condition internally during construction. All material shall be kept at proper temperature to assure proper jointing. Pipe and fittings shall be corresponding materials when assembled.

E. Provide clearance for access to valve and piping specialties to facilitate maintenance and repair or replacement.

F. Pipe shall be hung from building members using concrete inserts or beam clamps. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

G. Install sprinkler piping so that the system can be drained in accordance with NFPA 13. Where possible, slope to main drain valve. Slope dry pipe, deluge, and pre-action systems subject to freezing at minimum ¼" in 10' on mains and 1/2" in 10' on branches. Where piping not susceptible to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or ball valve with hose thread outlet and cap for drainage over 5 gallons. Pipe main drain valve, inspector's tests, and auxiliary drains to grade or to air gap sewer receptor.

H. Piping between dry pipe, pre-action or deluge valves and sprinkler heads and test/auxiliary drain piping shall be galvanized steel to retard or eliminate corrosion due to oxidation in these sub-systems. Fittings shall match piping installed, such as galvanized fittings on galvanized pipe. Provide dielectric fittings between dissimilar pipe materials.

I. Mitered ells, notched tees, and orange peel reducers are not acceptable. Bushings and reducing couplings are not acceptable.

J. Install auxiliary drains at all low points in the system and as required by the referenced standards. The drain shall consist of, as a minimum, a 1-inch ball valve, 1-inch brass nipple with ¾ -inch male hose threads, and cap.

K. Fire Barrier Penetrations: Where pipes pass through fire-rated wall assemblies, partitions, ceilings or floors, the fire rating integrity shall be maintained.

L. Do not install piping within exterior walls.

M. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

N. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.02. PREPARATION

A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.03. WELDED PIPE JOINTS

A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (½) the diameter of the main.

3.04. THREADED PIPE JOINTS

A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.05. MECHANICAL GROOVED PIPE CONNECTIONS

A. Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in accordance with the same specifications using specially designed tools for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications.

3.06. MECHANICALLY FORMED TEE FITTINGS

A. Form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. Use an adjustable collaring device. Notch and dimple the branch tube. Braze the joint with neutral flame oxy-acetylene torch, applying heat properly so that pipe and tee do not distort; remove distorted connections.

3.07. UNIONS AND FLANGES

A. Install a union or flanges at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.08. PIPING SYSTEM LEAK TESTS

A. Conduct pressure test with test medium of water. If leaks are found, repair the area with new materials and repeat the test; caulking with not be acceptable.

B. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Entire test must be witnessed by the Architect/Engineer.

C. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.

D. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

E. Conduct flushing of the underground water/fire main service as required by NFPA 13. The 200 PSI pressure test of the main shall be conducted by the installer of the main.

F. Hydrostatically test system at 200 psi for 2 hours showing no leakage. Where system design is in excess of 150 psig. Test at a pressure 50 psig above system design pressure.

G. For dry and preaction systems, pneumatically test system at 40 psi for 24 hours showing no leakage.

H. All pressure tests are to be documented on NFPA Contractor's Material and Test Certificate forms.

3.09. SPRINKLER HEADS

A. Install sprinkler heads as recommended by manufacturer. Locate sprinkler heads as indicated on approved shop drawings and reflected ceiling plan maintaining minimum clearances from obstructions, ceilings and walls. Install sprinkler heads level in locations not subject to spray pattern interference. When ducts, lights, or other objects are obstructions to sprinkler distribution, additional heads shall be provided beneath the obstruction.

B. All sprinkler heads installed in finished ceilings shall be fed by a swing joint or return bend arrangement for final positioning in ceiling grid pattern during construction phases.

C. <u>For areas with finished ceilings, sprinkler head layout shall be based on center-of-tile placement.</u>

D. Install sprinkler heads level in locations not subject to spray pattern interference.

3.10. GAUGES

A. Provide a valved pressure gauge in main fire protection riser, at or near each test connection, and at the top of each piping riser. Provide gage with a connection having a soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and where they will not be subject to freezing.

3.11. VALVES

A. Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations which allow access for operation, servicing and replacement. Install all valves with the stem in the upright or horizontal position. Valves installed with the stems down will not be accepted. Provide a riser shutoff valve and a

capped hose thread drain valve at the bottom of each riser. Provide capped hose thread drain valves to allow draining of each portion of piping.

B. Install supervised-open gate valves located to control all sources of water supply except fire department connections. Each building shall have independent control valves for each sprinkler riser.

C. Provide permanently marked identification signs indicating the portion of the system controlled by each valve.

D. Provide tamper switch on each shut-off valve.

E. Install locking device with each shut-off valve to prevent inadvertent closing of the valve. Keys shall be indexed to identify valve location.

3.12. SPECIALTY VALVES

A. Install in vertical position fire protection riser. Install trim recommended by manufacturer including drain and test valves. Pipe drains to hub or floor drains. Test and adjust operation of valves, alarms, pressure maintenance devices, and deluge/preaction controls.

3.13. FIRE DEPARTMENT AND FIRE PUMP TEST CONNECTIONS

A. Mount free-standing as indicated on the drawings. Coordinate and verify final location with Owner prior to installation. Locate between 2-feet to 3-feet above grade.

B. Provide ½ - inch automatic drip drain on inlet of fire department connection check valve and where indicated.

3.14. HOSE OUTLET VALVES

A. Install at each standpipe outlet and elsewhere where indicated approximately 3′-6″ to 4'-0″ above floor.

3.14. DOUBLE CHECK VALVE ASSEMBLY

A. Double check valve assembly shall be installed in one location to supply water to all sprinkler zones. Install per Wisconsin Administrative Code requirements.

3.15. CONDENSATION TRAPS AND DRAINS

A. Provide sufficient condensation traps and drains for dry pipe system throughout the building in areas where plumbing drains are available to discharge the condensate. If condensate drains are required where no plumbing drains are available, notify the Architect/Engineer as soon as possible to provide a means for drainage or to determine if drainage can be accomplished manually with buckets.

3.16. TEST CONNECTIONS

A. Install test connections sized and located in accordance with NFPA Standards, complete with shut-off valve. Test connections may also serve as drain pipes.

B. Provide test connections for each flow switch. Test connections shall discharge to appropriate receptacles. Outside discharge shall not be allowed.

C. When test valves are located remote from the flow switch, the valve shall be identified with a brass tag denoting which flow switch is being tested.

3.10. TESTING

A. Flush, test, and inspect sprinkler piping systems in accordance with NFPA 13.

B. The sprinkler system shall be tested as an entire system or partial system. The system shall be hydrostatically tested at 200 psi for two hours. No leakage allowed. All defective joints shall be replaced with new materials. No caulking of defective joints shall be allowed. After defective joints are replaced, the system shall be re-tested until satisfactory results are obtained. Pipe shall not be concealed until satisfactorily pressure tested.

C. Architect and Owner shall be notified 24 hours prior to any pressure test. This test shall be performed in the presence of appropriate representatives for the Owner and the Architect or Engineer. A log of tests shall be kept stating: who performed test, time and date of test, what section of system was tested, and results of test with properly executed Contractor's Material and Test Certification forms from NFPA 13, Chapter 8. This log shall be kept at the job site and submitted to the Engineer for approval.

D. Flow switches and pressure switches shall be operated to test that proper signals are transmitted to the Fire Alarm System.

E. Include tests for tamper switches.

END OF SECTION 15300C

SECTION 15320C

FIRE PUMPS

1. PART 1 – GENERAL

1.01. SCOPE

A. This section includes specifications for supports of all fire protection equipment and materials as well as piping system anchors.

1.02. REFERENCE

A. Drawings and general provisions of the contract, including General and Supplementary Conditions, and the applicable provisions of Division 1, govern work under this section.

1.03. RELATED WORK

A. The following technical fire suppression specifications sections are directly related to the provisions of this section.

Section 15000C – Common Work Results for Fire Suppression
Section 15060C – Fire Suppression Pipe and Fittings
Section 15140C – Fire Suppression Hangers and Supports
Section 15300C – Water-Based Fire Suppression Systems
Division 16 - Electrical.

1.04. REFERENCE STANDARDS

A. Specific standards referenced in this section are as follows:

ASSE 1015	Double Check Valve Backflow Preventers.
NFPA 13	Installation of sprinkler systems.
NFPA 14	Installation of standpipe and hose systems.
NFPA 20	Installation of centrifugal fire pumps.
NFPA 71	Installation, maintenance and use of signaling systems for central station service
NFPA 72	Installation, maintenance and use of protective signaling systems

1.05. QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

B. Conform to NFPA 20 for fire pumps.

C. Welding Materials and Procedures: Conform to ASME Code.

D. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.06. SHOP DRAWINGS

A. Submit fabrication drawings showing pipe sizes, fittings, devices and locations. Submit corresponding hydraulic calculations.

B. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, pump curves, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

1.07. CERTIFICATIONS

A. Fire protection system components to be UL listed and labeled. All components to be Factory Mutual approved with the exception of sprinkler heads, double check valves and air compressors. All system components shall be in conformance with NFPA rulings.

1.08. DELIVERY, STORAGE, AND HANDLING

A. Refer to General Conditions and Section 15000c.

B. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

C. Deliver products to site under the applicable provisions of Division 1 (Section 01600). Deliver pumps in the original shipping containers, with labeling in place.

D. Cover to prevent corrosion and deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage or by durable, waterproof, above ground packaging.

E. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

F. Storage and protection methods must allow inspection to verify products.

1.09. DESIGN CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, specifications as listed in this specification.

B. Construct all piping for the highest pressures and temperatures in the respective system, but not less then 175 psig. If system pressure exceeds 175 psig, contractor shall use fittings, valves, and appurtenances rated for system pressure.

C. Component design, construction and installation to comply with requirements of reference standards.

1.10. ELECTRICAL COORDINATION

A. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the power side of the control of fire protection motors or electrical equipment shall be furnished by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.

B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this Contractor. Should any change in size, horsepower rating or means of control be made to any motor or other electrical equipment after contracts are awarded, Contractor is to immediately notify the Electrical Contractor of this change and pay any costs due to this change.

C. Electrical Contractor shall provide all power wiring and the Fire Suppression Contractor shall provide all control wiring. Control wiring shall conform to Division 16 requirements for Control Wiring.

D. Furnish wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor.

2. PART 2 – PRODUCTS

2.01. HORIZONTAL SPLIT CASE CENTRIFUGAL FIRE PUMP

A. Manufacturer: Allis Chalmers, Aurora, Fairbanks Morse, ITT A-C, Patterson, Peerless, Systecon, Weil.

B. Type: Horizontal shaft, single stage, single or double suction, horizontal split casing, 175 psig working pressure at operating temperature of 225F continuous, 250F intermittent.

C. Casing: Cast iron with suction and discharge gauge ports, renewable bronze wear rings, vent and drain plugs, flanged suction and discharge connections.

D. Impeller: Bronze, hydraulically and dynamically balanced, keyed and locked to pump shaft, and protected by a replaceable bronze shaft sleeve.

E. Bearings: Oil or grease lubricated ball or roller bearings, single row inboard and double row outboard.

F. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

G. Seal: Stuffing box with split bronze packing gland, graphite impregnated TFE packing rings and water seal.

H. Drive: Flexible spacer type coupling or coupling with extended hub to allow for pump service. Provide guard for shaft/coupling assembly.

I. Motor: Provide pump with a motor sized for non-overloading over the entire pump curve. Motors to be 1750 rpm, open drip proof, squirrel cage induction.

J. Baseplate: Cast iron or fabricated steel with integral drain rim and grout base.

K. Accessories: Suction and discharge gauges and gauge cocks, casing relief valve, automatic air release valve and eccentric suction reducer.

L. Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current. The manufacturer shall certify all pump ratings.

2.02. FIRE PUMP CONTROLLER

A. Manufacturer: ITT, Josyln/Clark, Master Control Systems

B. General: Select fire pump controller with electrical characteristics matching pump motor. Factory fabricate and test fire pump controller assembly. Identify assembly with "Fire Pump Controller" label on control panel face. Permanently attach wiring diagrams to inside of cabinet. Provide cabinet and door mounted nameplates identifying each device or switch mounted within cabinet and on door, panel manufacturer and model number.

C. Enclosure: Floor mounted formed and welded steel, NEMA 12, with hinged and latched door, phosphatized and baked enamel finish.

D. Motor Starter: Class A, NEMA ICS 2, across-the-line magnetic full voltage starting, non-reversing type. Capable of automatic start initiated by low water pressure switch, remote starting by a normally closed contact and manual starting by front panel mounted control.

E. Overcurrent Protection: Circuit breakers with test switch and self-contained electronic trip circuit designed and listed for fire pump locked rotor application. Connect directly to HOA switch load side.

F. Controls: Front panel mounted hand-off-auto switch, 300 psi brass mercoid water pressure switch with low turn on and high turn off adjustable settings and exterior brass bulkhead connection, minimum run timer with manual stop switch, restart time delay. Provide phase reversal relay.

G. Alarms: Local audible and visual alarm indication as well as remote contacts for loss of power, and phase reversal along with alarm silence switch. Remote contact for fire pump operation (motor current greater than 20% FLA).

H. Wiring: Terminations for exterior power and control connections, space in cabinet for terminating incoming and outgoing cables at entry, identification of power and control wiring at terminals and ground bar.

2.03. PRESSURE BOOSTER PUMP CONTROLLER

A. Manufacturer: ITT, Josyln/Clark, Master Control Systems.

B. General: Select booster pump controller with electrical characteristics matching pump motor. Permanently attach wiring diagrams to inside of cabinet.

C. Enclosure: Wall mounted formed and welded steel, NEMA 2, gasketed with driphood, hinged and latched door, phosphatized and baked enamel finish.

D. Motor Starter: Class A, NEMA ICS 2, across-the-line magnetic full voltage starting, non-reversing type with overload relays. Capable of automatic start initiated by low water pressure switch and manual starting by front panel mounted control.

E. Overcurrent Protection: Fusible disconnect switch with panel face mounted handle.

F. Controls: Front panel mounted hand-off-auto switch, 300 psi brass mercoid water pressure switch with low turn on and high turn off adjustable settings and exterior brass bulkhead connection, minimum run timer.

G. Alarms: Contacts for remote indication of pressure booster pump running (motor current greater than 20% FLA).

H. Wiring: Terminations for exterior power and control connections, space in cabinet for terminating incoming and outgoing cables at entry, identification of power and control wiring at terminals.

3. PART 3 – EXECUTION

3.01. INSTALLATION

A. Install fire protection system components in accordance with NFPA rulings, listings and manufacturers recommendations. Locate where accessible for servicing and replacement.

B. Pumps: Set base mounted pumps on concrete bases, or concrete inertia base, level and bolt down prior to grouting. Fill the entire base with non-shrinking grout when required by the manufacturer's installation instructions.

C. Align all flexible coupled base-mounted pumps in accordance with the manufacturer's instructions.

D. Decrease from line size at pump connections with eccentric suction reducer offset with the top of the pipe level. All pump valves and piping specialties must be full line size. Support piping adjacent to pump such that no weight is carried on pump casings. For base mounted pumps, provide supports for elbows on pump suction and discharge piping 4" and over.

E. Provide automatic air vent, drain valve, relief valve and pressure gauges on pump casings.

F. Provide drains for bases and seals, piped to and discharging into floor drains.

G. Provide 1/2" Type L copper pressure sensor line from between pump discharge check valve and shutoff valve to pump controller pressure switch. Provide bronze swing check valve with 3/32" orifice in clapper along with two test valves and intermediate tee with 1/4" test plug at pump and at controller for testing and relieving pressure (NFPA 20, A-7-5.2.1). Each pump, including pressure booster pump, to have its own dedicated sensor line.

H. Lubricate pumps before startup.

I. Fire Pump Controller: Install on concrete housekeeping pad, leveled and bolted in place or mount securely to wall. Pipe pressure sensor line to controller. Coordinate wiring with electrical contractor. Startup, test and adjust for proper operation of alarms and operating controls. Adjust pressure switches in accordance with NFPA 20, A-11-4.

J. Pressure Booster Pump Controller: Mount securely on wall. Pipe pressure sensor line to controller. Coordinate wiring with electrical contractor. Startup, test and adjust for proper operation of alarms and operating controls. Adjust pressure switches in accordance with NFPA, A-11-4.

END OF SECTION 15320C

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Mechanical Requirements specifically applicable to Division 15 Sections.

1.2 SCOPE OF WORK

A. The following description is a general description of the HVAC work for this project. This work description is not all inclusive but is offered to give the Contractor a general idea of the scope of the project.

1. HVAC work includes but is not limited to the following:

a. Provide new exhaust fan EF-1 as a part of this project. Provide necessary ductwork and ductwork accessories as a part of this project.

b. Provide new transfer grilles and louver to remove air from the fire pump room.

c. Provide controls system and control to operate the new exhaust fan and dampers to operate independently from any building automation system (BAS).

1.3 DEFINITIONS

A. The following words or phrases have special meaning when used in the articles of this division and in any other requirements applicable to this division:

1. "Exposed to View" or "Exposed" — shall have reference to and mean that the pipes, ducts, etc., insulated or otherwise, in the completed structure are visible within any normally occupied space, room or area.
2. "In Concealed Spaces", "Concealed or "Not Exposed to View" — shall have reference to and mean that the pipes, duct, etc., insulated or otherwise are concealed and not exposed to view within furred spaces, above suspended ceilings, pipe chases, etc.
3. "Unfinished Spaces" or "Unfinished Rooms" — shall have reference to areas such as Machine Rooms, Equipment Rooms, or similar areas. Where the words "In Finished Areas" or "Finished Rooms" are used, it shall have reference to rooms or spaces, such as, Reading rooms, Offices, Public Corridors, etc.
4. "Finished Rooms or Spaces" shall refer to areas similar to offices, public corridors, and public toilet rooms.
5. "Provide" — shall be taken to mean "furnish and install" meaning to purchase and deliver to the job site and the installation thereof.
6. "Piping" — shall include, in addition to pipe all fittings, valves, hangers, and other supports, expansion compensators, anchors, and accessories related to such piping including associated insulation.

7. "Ductwork" — shall include, in addition to ducts, all fittings, transitions, dampers, hangers and other supports, fire dampers, access panels, associated insulation and accessories related to such ductwork.
8. "Contractor" in Specifications and Drawing refers to respective Contractor performing that portion of work.
9. "Invert Elevation" (I.E.) means elevation of inside bottom of pipe or duct.
10. "Mechanical Work" is work in Division 15.

NOTE: The words "Contractor shall" are implied and shall be so understood wherever the directions "furnish," "install" or "provide" are used.

1.4 SPECIAL CONDITIONS

A. Minor items and accessories or devices reasonably inferable as necessary to the complete and proper operation of any system shall be provided by the Contractor for such system whether or not they are specifically called for by the Specifications or Drawings.

B. Where work specified in other sections of the specifications connects to equipment specified in Division 15 Sections, check the required connection to such equipment.

1.5 CODES AND STANDARDS

A. The Work governed by this Division shall comply with the latest editions of the following applicable standard specifications and codes. For other standard specifications, if included by reference, see Division 1 of the Specifications.

AABC	Associated Air Balance Council
ADC	Air Diffusion Council
AIA	American Institute of Architects
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASE	Association of Safety Engineers
ASHRAE	American Society of Heating Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CAGI	Compressed Air and Gas Institute
EPA	Environmental Protection Agency
FIA	Factory Insurance Association
FM	Factory Mutual Insurance Association
HYDI	Hydronics Institute
IBC	International Building Codes
IDPH	Illinois Department of Public Health
IEEE	Institute of Electrical and Electronics Engineers
MCAA	Mechanical Contractors Association of America
NBS	National Bureau of Standards

NEC	National Electric Code
NEMA	National Electrical Manufacturers Assoc.
NFPA	National Fire Protection Association
NSC	National Safety Council
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act
SMACNA	Sheet Metal and Air Conditioning Contractor's Association
UL	Underwriter's Laboratories, Inc.

1.6 WORK BY CITY

A. The following work shall be by the City:

1. Testing and balancing by others under a separate contract with the City.

1.7 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of City before proceeding.

1.8 CONTRACTOR USE OF PREMISES

A. Refer to Division 1.

B. Limit use of site and premises to allow:

1. City occupancy.
2. Use of premises by City to conduct normal activities.

a. Tie-ins to existing systems must be done in manner so as not to interfere with City's operations. All shut downs of existing services require a three day notice minimum in writing.

C. Schedule the Work to accommodate this requirement.

D. Cooperate with City to minimize conflict and to facilitate City's operations.

E. The City will be responsible for the identification and abatement of all hazardous materials and asbestos associated with the project. Although great care will be taken to eliminate any risks, the Contractor must be aware that hazardous materials may exist on site. Therefore, the Contractor shall immediately suspend work and notify the City if asbestos or other hazardous material is suspected in the work area of the project.

1.9 WORK SEQUENCE

A. Install work in phases to accommodate City's occupancy requirements during the construction period. Coordinate mechanical schedule with other trades and other operations.

1.10 REFERENCE STANDARDS

A. Quality Assurance

1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
2. Conform to reference standard by date of issue current on date of Contract Documents date for receiving bids date of City-Contractor Agreement when there are no Bid dates specified.
3. Obtain copies of standards when required by Contract Documents.
4. Maintain copy of applicable standard at job site during submittals, planning and progress of the specific work, until Substantial Completion.
5. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
6. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

B. Reference Standards and Specification Abbreviations

1. Refer to Division 1 and Division 15, Applicable Sections.

1.11 SUBMITTALS

A. Shop drawings and samples shall be submitted in compliance with the Conditions of the Contract and General Requirements.

B. Submittals shall contain outline dimensions, operating and maintenance clearances and sufficient engineering data to indicate compliance with the specifications. Each submittal shall be clearly labeled as indicated in the Conditions of the Contract and General Requirements.

C. Each piece of equipment shall be identified by the number shown in the schedules and by specification article number pertaining to the item. Shop drawings shall as a minimum be ¼" equals 1'-0" scale, and shall be newly prepared by the Contractor and not reproduced from the Engineer's drawings. Layouts shall be made for all floor plans including all ductwork, piping, electrical distribution and other mechanical equipment. Layouts shall show clearances of piping, ducts, etc., above floor.

D. Contractor shall obtain Engineer's approval on all the work before any equipment is purchased, or any work installed. Contractor shall also secure approval of the Governmental Authorities having jurisdiction on all equipment and on the layout of the complete system.

E. The Engineer's review and approval of shop drawings is a gratuitous assistance and in no way does it relieve the Contractor from responsibility for errors or omissions which may exist on the shop drawings. Where such errors or omissions are discovered later, they must be made good by the Contractor, without any additional cost to the City, irrespective of any approval by the Engineer.

1. The Contractor shall incorporate with his shop drawings, a letter indicating all deviations from the plans and/or specifications. If in the opinion of the Engineer, the deviations are not equal, the Contractor will be required to furnish the item as specified and as indicated on the drawings.
2. Record documents shall be submitted in compliance with the requirements of the Specifications.

F. Shop Drawings Submittal Procedures:

1. Submit one (1) copy of manufacturer's certified shop drawings via email to Engineer for all equipment and controls.
2. Drawings shall include detailed dimensions, capacities, gauges, arrangement and operating clearances.
3. Incomplete submittals shall not be reviewed and Contractor will be held responsible for correction of work not having final approval.
4. Engineer shall review or take other appropriate action on Contractor submittals, such as certified shop drawings, product data, samples and other data, which Contractor is required to submit, but only for limited purpose of checking for conformance with design concept and Contract Documents.
5. This review shall not include review of accuracy or completeness of details, such as quantities, dimensions, capacities, weights or gauges, fabrication processes, construction means or methods, coordination of work with other trades or construction safety precautions, all of which are the sole responsibility of Contractor.
6. Engineer's review shall be conducted with reasonable promptness while allowing sufficient time in Engineer's judgment to permit adequate review.
7. Review of specific items shall not indicate that Engineer has reviewed entire assembly of which said item is a component.
8. Engineer shall not be responsible for any deviations from Contract Documents not submitted to Engineer in writing by Contractor.
9. Engineer shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
10. Review of certified drawings does not relieve Contractor of responsibility of furnishing and install all system components, as per drawings and specifications for proper system operation with particular respect to BTU outputs, water and air flow capacities, minimum noise requirements and space limitations, nor from responsibility for errors or omissions of any sort in drawings.
11. Engineer assumes no responsibility for figured dimensions or exact quantities of materials on shop drawings.
12. Reviews by Engineer is subject to limitations of general conditions of the contract for construction.
13. Contractor shall thoroughly check all shop drawings prepared by subcontractors for materials or equipment suppliers with regard to measurements, size of members, materials and details to satisfy specifications and drawings.
14. Each drawing shall have a date of approval and signature of reviewer.
15. If Contractor's shop drawings have been submitted and reviewed by Engineer for a particular product and Engineer has stamped "rejected", "revised and resubmit" or "submit specified items" after two reviews, any further review by Engineer for that particular product will require contractor to compensate

Engineer for all time spend for further review of that product a rate of one hundred dollars ($100.00) per hour.

16. Furnish approved and corrected shop drawings to all other Contractors whose work is affected.

1.12 QUALITY CONTROL

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions and workmanship to product Work of specified quality.

B. Comply fully with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes or specified requirements indicate higher standards or more precise workmanship.

E. Work to be performed by persons qualified to produce workmanship of specified quality.

F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

G. Manufacturers' Field Services and Reports

1. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of installation, quality or workmanship, start-up of equipment, testing, adjusting and balancing of equipment and troubleshooting as applicable and to initiate instructions when necessary.
2. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
3. Submit report in duplicate within ten (10) days of observation to Engineer for review.

1.13 QUALITY ASSURANCE/CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions and workmanship to produce Work of specified quality.

B. Comply fully with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes or specified requirements indicate higher standards or more precise workmanship.

E. Work to be performed by persons qualified to produce workmanship of specified quality.

F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.14 MANUFACTURERS' FIELD SERVICES, FIELD TESTS AND REPORTS

A. When specified in individual specification Sections, Contractor shall require material or Product suppliers, Subcontractors, or manufacturers to provide qualified staff personnel to observe site conditions; testing; conditions of installation; quality of workmanship; start-up of equipment; testing, adjusting and balancing of equipment and materials; and troubleshooting as applicable and to initiate instructions when necessary. Submit report per paragraph C below, this section.

B. Report observations and site decisions or instructions given to City, applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Submit written report in duplicate within 10 days of observation, start-up, testing, etc. to Engineer for review.

1.15 CONTRACT CLOSEOUT

A. Final Cleaning

1. Refer to Division 1.
2. Execute final cleaning prior to final inspection.

B. Adjusting

1. Adjust operating products and equipment to ensure smooth and unhindered operation.

C. Project Record Documents

1. Refer to Division 1.
2. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

   a. Field changes of dimension and detail.
   b. Details not on original Contract Drawings.

3. Delete Engineer's title block and seal from all documents.
4. Submit documents to Engineer with claim for final application for payment.

D. Provide Maintenance Manuals as follows:

1. HVAC Contractor shall furnish to Engineer and City for approval, prior to installation of equipment three (3) bound copies of typewritten instructions covering complete maintenance and operation of said system and a complete set of drawings marked to show any and all deviations from original layout.

2. Contractor shall verbally instruct City on care and operation of all parts of system. Architect and Engineer may be present at verbal instruction. Contractor shall make available to City, any of their subcontractors or equipment manufacturers deemed necessary.

3. At least one month before warranty period expires, Contractor shall again meet with City for a review of original maintenance manuals and operating instructions.

4. Maintenance instructions shall include manufacturer's literature on all system equipment components.

5. All maintenance instructions shall be explicit concerning time intervals for all servicing and preventive maintenance types and grades of oil and/or grease, packing materials, normal and abnormal clearance, methods of equipment adjustments and complete description of replacement parts and materials for wearing items.

6. Maintenance instructions shall be required on all equipment and systems specified.

E. Provide Record Drawings as follows:

1. Contractor shall maintain at project site for City, one (1) record copy of all Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to record all changes made during construction and approved Shop Drawings, Project Data, and Samples.
2. Record documents shall be available to Engineer and shall be delivered to Engineer for City upon completion of work.

1.16 TRAINING OF CITY PERSONNEL

A. Instruct user agency personnel in the proper operation and maintenance of systems and equipment as provided as part of this project. Include not less than four hours of instruction, using the Operating and Maintenance Manual during this instruction. Demonstrate startup, operation and shutdown procedures for all equipment. All training shall be completed during normal working hours.

1.17 SPARE PARTS AND MAINTENANCE DATA

A. Provide products, spare parts, maintenance and materials in quantities specified in individual specification sections.

B. Deliver to project site and place in location as directed; obtain receipt prior to final payment.

1.18 WARRANTIES

A. Provide one year warranty of workmanship and materials provided under this project.

B. Provide notarized copies.

C. Execute and assemble documents from Subcontractors, suppliers and manufacturers.

D. Provide table of contents and assemble in 3-D side ring binder with durable cover.

E. Submit prior to final application for payment.

F. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.19 REGULATORY REQUIREMENTS

A. Conform to the International Building Code and the International Mechanical Code as amended and adopted by the State of Wisconsin, Ordinances of the City of Milwaukee and NFPA 13, latest editions.

B. Obtain permits and request inspections from the City of Milwaukee Building Department and any other Authorities Having Jurisdiction (AHJ).

C. Conform to all other governing agencies and authorities.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

A. Refer to Division 1.

B. Products

1. Products: Means new material, machinery, components, equipment, fixtures and systems forming Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of Work. Products may also include existing materials or components required for reuse.
2. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
3. Provide interchangeable components of same manufacturer for similar components.

C. Transportation and Handling

1. Transport and handle products in accordance with manufacturer's instructions.
2. Promptly inspect shipment to assure that products comply with requirements, quantities are correct and products are undamaged.

2.2 STORAGE AND PROTECTION

A. Refer to Division 1.

B. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate-controlled enclosures.

C. Provide off-site storage and protection when site does not permit on-site storage or protection.

D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.

E. Store loose granular materials on solid flat surfaces in a well-drained area. Provide mixing with foreign matter.

F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement or damage.

G. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

2.3 PRODUCT OPTIONS

A. Refer to Division 1.

B. Products Specified by Reference Standards or by Description only: Any product meeting those standards or description.

C. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications; no options or substitutions allowed.

1. Documents have been prepared utilizing a single manufacturer as the basis of design. Contractor shall be responsible for coordinating any varying requirements (e.g. space requirements, electrical requirement) when utilizing the other acceptable manufacturers.

PART 3 - EXECUTION

3.1 SCOPE

A. Work included under Division 15, Mechanical Work, shall include all labor, services, materials and equipment and performance of all work required for installation of mechanical systems as shown on Drawings and as herein specified in following sections.

3.2 INTERPRETATION OF CONTRACT DOCUMENTS

A. Should there be discrepancy or a question of intent, refer matter to Engineer for decision before ordering any equipment or materials or before starting any related work.

B. Drawings and Specifications are to be taken together. Work specified and not shown or work shown and not specified shall be performed or furnished as though mentioned in both Specifications and Drawings. If there is discrepancy between Drawings and Specifications as to quantity or quality to be provided, the greater quantity or better quality shall be provided.

C. Minor items and accessories or devices reasonably inferable as necessary to complete and proper installation and operation of any system shall be provided by Contractor for such system whether or not specifically called for by Specifications or Drawings.

D. Engineer may change location of any equipment 5′ and any piping, ductwork, conduit, etc. 10′ in any direction without extra charge, provided such changes are made before installation.

E. Locations of items not definitely fixed by dimensions are approximate only and exact locations necessary to secure the best conditions and results shall be determined at the site and shall be subject to review and approval by Engineer.

F. Follow drawings in laying out work, check drawings of other trades to verify spaces in which work will be installed, and maintain maximum headroom and space conditions at all points.

1. Where headroom or space conditions appear inadequate, notify Engineer or City's field representative before proceeding with installation.
2. Duct and pipe rerouting and duct size changes shall be made at no additional cost to the City.

G. Furnish advance information on locations and sizes of frames, boxes, sleeves and openings needed for the work, and also furnish information and shop drawings necessary to permit installation of other work without delay.

H. Where there is evidence that parts of the Work specified in Division 15 will interfere with other work, assist in working out space conditions to make satisfactory adjustments, revise and submit coordinated shop drawings.

I. After review and without additional cost to the City, make minor modifications in the work as required by structural interferences, by interferences with work of other sections or for proper execution of the work.

J. Work installed before coordinating with other work so as to cause interference with other work shall be changed and corrected without additional cost to the City.

K. Drawings are diagrammatic in nature and are a graphic representation of requirements and shall be followed as closely as actual building construction will permit. All changes from the plans necessary to make the work conform to the building as constructed and to fit the work of other trades or to conform to rules of the Governmental Authorities having jurisdiction, NFPA, OSHA and the City's Insurance Underwriters, shall be made by the Contractor without extra cost to the City.

L. The layout of the piping, ductwork, equipment, etc., as shown on the drawings shall be checked and exact locations shall be determined by the dimensions of the equipment approved and the Contractor shall obtain approval for the revised layout before the apparatus is installed. The Contractor shall field measure or consult existing record Architectural and Structural Drawings if available for all dimensions, locations of partitions, locations and sizes of structural supports, foundations, etc.

M. Omission in the Drawings and/or Specifications of any items necessary for the proper completion or operation of the work outlined in this specification shall not relieve the Contractor from furnishing same without additional cost to the City.

N. The Equipment Shop Drawings will be furnished to the Contractor before roughing-in. Contractor shall not install any piping or ductwork for said equipment until he has received approved shop drawings for same.

3.3 PROJECT/SITE CONDITIONS

A. Each Contractor shall visit the site prior to bid submission to determine all existing conditions that may affect his work and shall make appropriate allowances for such conditions in his bid. Failure to visit the site shall not be cause for a request for additional compensation later in the project during construction.

B. Install Work in locations shown on Drawings, unless prevented by Project conditions.

C. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of City and Engineer before proceeding.

3.4 ALTERATIONS IN PRESENT BUILDING AND SYSTEMS

A. Contractor shall take particular note of the revisions and alterations to the existing systems, facilities and equipment due to the new construction as indicated on the Drawings and/or in Specification. Contractor shall remove, reroute or alter all services, ductwork, etc., as required or as indicated on the drawings.

1. The Contractor shall maintain all services in the existing building. In case, where new service connections are to be made to existing services and service interruptions can in no way be avoided, the service interruptions shall be with the minimum of inconvenience to the City and the work shall be done at such time of any day, Saturday and Sunday included, and only as directed by the City or the Engineer.

3.5 ERECTION & WORKMANSHIP

A. Contractor is to be responsible for all work fitting into place in satisfactory, neat and workmanlike manner in every particular, to approval of Engineer.

B. Unless explicitly stated to contrary, each Contractor shall furnish and install each item of equipment or material hereinafter specified, complete with all necessary fittings, supports, trim, piping, insulation, etc., as required for complete and operating installation.

C. Equipment and materials shall be installed according to manufacturer's instruction unless otherwise specifically directed by Contract Documents

D. Contractor shall provide all necessary OSHA approved rigging, scaffolding, tools, tackle, labor, etc., necessary for the complete installation of the equipment.

E. Contractor shall adapt his work to job conditions and make such changes as required and permitted by the City and Engineer such as moving his work to clear beams, joints, light fixtures, etc., adjusting risers, etc. avoiding interferences with windows and openings, etc. raising or lowering his work to permit the passing of ductwork or the work of other trades, etc., all as required or as job conditions dictate, without any additional costs to the City.

F. All appliances and equipment shall be installed and connected with best engineering practices and in accordance with the manufacturer's best instructions and recommendations.

G. Work done by Contractor at the site in the execution of this Project shall be performed only by skilled mechanics, recognized as such in their respective trades in the direct employ either of the Contractor proper or of affiliate firms which have a longstanding and continuing formal agreement with the Contractor for providing the rendered services on similar work of this type.

3.6 PROTECTION FROM INJURY

A. All pipes, fixtures, traps, equipment, and other parts of the Work shall be protected against injury by freezing or exposure to the weather during construction while stored or installed in place.

3.7 MECHANICAL AND ELECTRICAL WORK COORDINATION

A. Refer to Division 1.

B. Provide coordination for type of mechanical and electrical work required for this project for duration of work.

C. Submittals

1. Coordinate mechanical and electrical work of Divisions 15 and 16 with work of each other and of other Divisions.
2. Coordinate progress schedules, including dates for submittals and for delivery of products.
3. Coordinate location and verify size of pipes, equipment, fixtures, conduit, ducts, openings, switches, outlets, fire sprinkler heads, fire hose cabinets, etc., in progress of the Work. Architectural Drawings shall take precedence over Mechanical and Electrical Drawings.
4. Participate in progress meetings. Report on progress of work to be adjusted under coordination requirements and any required changes in schedules. Transmit minutes of meetings and reports to concerned parties.

D. Coordination of Submittals

1. Review shop drawings, product data, and sample for compliance with Contract Documents and for coordination among work of all sections of Project Manual. Transmit to Engineer.
2. Check field dimensions and clearances and relationship to available space and anchors.
3. Check compatibility with equipment and work of other sections, electrical characteristics and operational control requirements.
4. Check motor voltages and control characteristics.
5. Coordinate controls, interlocks, wiring of pneumatic switches and relays.
6. Coordinate wiring and control diagrams.
7. Review effect of any changes on work of other sections.
8. Verify and coordinate maintenance of Record Documents.

E. Coordination of Substitutions and Modifications

1. Review proposals and requests from subcontractors.

2. Verify compliance with Contract Documents and for compatibility with work and products of other sections.
3. Submit to Engineer with recommendation for action.

F. Observation of Work

1. Observe work for compliance with Contract Documents.
2. Maintain list of observed deficiencies and defects; promptly submit to Engineer.

G. Documentation

1. Observe and maintain a record of tests. Record:

   a. Specification section number, product, and name of subcontractor.
   b. Name of testing agency and name of inspector.
   c. Name of manufacturer's representative present.
   d. Date, time, and duration of tests.
   e. Type of test, and results.
   f. Retesting required.

2. Assemble background documentation for dispute and claim settlement by Engineer.
3. Submit copies of documentation to Engineer upon request.

H. Equipment Start-Up

1. Verify utilities, connections and controls are complete and equipment is in operable condition.
2. Observe start-up and adjustments; record time and date of start-up and results.
3. Observe equipment demonstrations to City; record times and additional information required for Operation and Maintenance Manuals.

I. Inspection and Acceptance of Equipment

1. Prior to inspection, verify that equipment is tested and operational, and clean.
2. Assist Engineer with inspection. Prepare list of items to be completed and corrected.

3.8 CUTTING AND PATCHING

A. Refer to Division 1.

B. Submit written request in advance of cutting or alteration which affects:

1. Structural integrity of any element of Project.
2. Integrity of weather-exposed or moisture-resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight-exposed elements.
5. Work of City or separate contractor.

C. Include in request:

1. Effect on work of City or separate contractor.
2. Written permission of affected separate contractor.

3. All items requested in Division 1.

D. Examination

1. Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
2. After uncovering existing work, inspect conditions affecting performance of work.
3. Beginning of cutting or patching means acceptance of existing conditions.

E. Preparation

1. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
2. Provide protection from elements for areas which may be exposed by uncovering work.
3. Maintain excavations free of water.

F. Cutting and Patching

1. Cutting and patching required to access work in existing walls, in chases, above inaccessible ceilings, below floors, etc., shall be by the Contractor who requires the access, unless shown on the bid documents otherwise or noted otherwise.
2. The Contractor shall do all cutting, or fitting of the work as required to make its several parts fit together, or to receive the work of others, as shown or reasonably implied by the drawings or specifications, or as may be directed by Buildings & Fleet Services. Holes cut in exterior walls and/or roofs shall be waterproofed.
3. The Contractor who cuts shall also be responsible for patching. Where cutting and patching is required, the Contractor shall hire individuals skilled in such work to do cutting and patching.
4. The Contractor who removes or relocates building components which leaves a remaining opening shall be responsible for patching the opening.
5. Patching includes repairing openings to match adjacent construction and painting the surface to match existing. Painting means covering the entire wall where patching is to be done to nearest break point or corner unless indicated to be done by other trades.
6. Contractor shall not endanger any work by cutting, digging or otherwise and shall not cut or alter the work of others without their consent.
7. Do not pierce beams or columns without permission of Buildings & Fleet Services and then only as directed in writing. If any ductwork, piping, conduit, etc. is required through walls or floors where no sleeve has been provided, use a core drill or saw cut to prevent damage and structural weakening.
8. Wherever any material, finish, or equipment, is damaged, the skilled trade shall accomplish the repair or replacement, in that particular work and the cost shall be charged to the party responsible for the damage. Buildings & Fleet Services reserves the right to disallow any means and/or methods that, in the opinion of Buildings & Fleet Services, are harmful to and/or not in the best interest of preserving the improvements receiving the work.

G. Performance

1. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
2. Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
3. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
4. Restore work with new products in accordance with requirements of Contract Documents.
5. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
6. At penetrations of fire-rated walls, partitions, ceiling, or floor construction, completely seal voids with fire-rated fire resistant material to full thickness of the penetrated element.
7. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.9 SOUND CONTROL

A. Conduits shall be grouted or sealed tightly in place.

B. Piping, ductwork, etc. shall pass through sleeves. Pack sleeves tight with glass fiber or oakum and caulked on both sides with non-hardening acoustical sealant.

3.10 FIRE RATED PENETRATIONS

A. Sleeves for pipes and ducts through fire rated and fire resistive floors and walls shall be constructed of materials classified by UL to provide fire stopping equal to time rating of construction being penetrated. Use asbestos free materials that comply with applicable codes and have been tested under positive pressure in accordance with UL 1479 or ASTM E 814.

B. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instruction.

C. Seal holes or voids made be penetrations to ensure an effective smoke barrier.

D. Where floor openings without penetrating items are more than 4" in width and subject to traffic or loading, install fire stopping materials capable of supporting same loading as floor.

E. Protect materials from damage on surfaces subject to traffic.

F. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.

G. Keep areas of work accessible until inspection by applicable code authorities.

H. Perform under this section patching and repairing of fire stopping caused by cutting or penetration by other trades.

I. Clean up spills of liquid components.

J. Neatly cut and trim materials as required.

K. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.11 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Engineer and City seven days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence or other conditions which may cause damage.

D. Verify that tests, meter readings and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of responsible manufacturer's representative or Contractors' personnel in accordance with manufacturers' instructions.

G. When specified in individual specification sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up and to supervise placing equipment or system in operation.

H. Submit a written report in accordance with paragraph 1.14 previously specified that equipment or system has been properly installed and is functioning correctly.

3.12 TESTING, ADJUSTING AND BALANCING

A. The City of Milwaukee shall appoint, employ and pay for services of independent firm to perform testing, adjusting and balancing.

B. Independent firm will perform services specified in Division 1, and Section 15990.

C. Reports will be submitted by independent firm to Engineer indicating observations and results of tests and indicating compliance or non-compliance with specified requirements and with requirements of Contract Documents.

-- END OF SECTION --

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SECTION 15140
SUPPORTS, ANCHORS AND SLEEVES

1. PART 1 - GENERAL

1.1 WORK INCLUDED

A. Duct hangers and supports.

B. Flashing.

C. Sleeves and seals.

D. Miscellaneous materials.

E. Anchors.

1.2 RELATED WORK

A. Section 15010 - Basic Mechanical Requirements.

B. Section 15242 - Vibration Isolation.

C. Section 15250 - Thermal Insulation.

D. Section 15860 - Centrifugal Fans.

E. Section 15890 - Ductwork.

F. Section 15910 - Ductwork Accessories.

1.3 REFERENCES

A. SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

B. UL - Underwriters Laboratories.

C. UL 1479 - Firestops, Fire Tests of Through-Penetration.

D. FM - Factory Mutual.

1.4 QUALITY ASSURANCE

A. Refer to General Conditions, Division 1 and 15010.

B. UL and FM Compliance: Provide products which are UL listed and FM approved.

C. MSS Standard Compliance:

1. Provide pipe hangers and supports of which materials, design and manufacture comply with MSS SP-58.

2. Select and apply pipe hangers and supports, complying with MSS SP-69.

3. Fabricate and install pipe hangers and supports, complying with MSS SP-89.

4. Terminology used in this section is defined in MSS SP-90.

1.5 SUBMITTALS

A. Refer to General Conditions and Division 1 and Section 15010.

B. Submit product data under provisions of Section 01300.

C. Indicate hanger and support framing and attachment methods.

2. PART 2 - PRODUCTS

2.1 DUCT HANGERS

A. Duct hangers shall be strips of galvanized steel or round steel rod and shall comply with SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

2.2 HANGER RODS

A. Steel Hanger Rods: Threaded both ends.

B. Duct hangers made of round steel rod are to be uncoated hot-rolled steel except where installation is in corrosive atmosphere, then hanger rods should be electro galvanized all thread rod or hot dipped galvanized rods with threads painted after installation.

2.3 FLASHING

A. Metal Flashing: 26 gauge galvanized steel.

B. Lead Flashing: 5 lb/sq ft sheet lead for waterproofing; one lb/sq ft sheet lead for soundproofing.

C. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

2.4 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gauge galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls and Footings: Form with standard weight steel pipe.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed complying with ASTM E814. Fire penetrators manufactured by ProSet Systems.

D. Sleeves for Round Ductwork: Form with 18 gauge galvanized steel.

E. Sleeves for Rectangular Ductwork: Form with 18 gauge galvanized steel.

F. Penetration Stuffing and Damming Materials

1. Fire, Smoke and Fume Stops: Fiberglass batt insulation, mineral wool or backer block where damming is required.

2. Non-Fire Rated Penetrations: Fiberglass batt insulation or mineral wool.

G. Caulking

1. Fire, Smoke and Fume Stops

a. Cracks, voids or holes up to 4″ diameter: Use putty or caulking, one-piece intumescent elastomer, non-corrosive to metal and capable of expanding 10 times when exposed to temperatures of 250F to 350F and have I.C.B.O., B.O.C.A.I. and S.B.C.C.I. (NRB243) and NFPA 101 approved ratings to three hours per ASTM E-814 (UL 1479). At contractor's option, Chase Foam CTC-PR-855 may be used, where approved by the governing agencies.

b. Opening 4″ or greater: Use intumescent elastomer sealing system capable of passing 3-hour fire test in accordance with ASTM E-814 (UL 1479), consisting of wall wrap or liner, partitions and end caps capable of expanding 10 times when exposed to temperatures of 250F to 350F.

c. Materials shall be UL listed fire barrier caulk, wrap/strip, moldable putty and sheet forms.

d. Subject to compliance with requirements, provide fire barrier penetration seals by one of the following:

3M Fire Protection Products
Chase Technology Corporation
Nelson; Unit of General Signal

e. Use proper UL through-penetration firestop systems required for materials passing through sleeves.

2.5 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

C. Provide copper plated hangers and supports for copper piping. Insulated copper pipe will not require copper plated hangers and supports.

D. Duct hangers shall comply with SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

2.6 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

2.7 FINISH

A. Prime coat exposed steel hangers, guides, anchors and supports. Hangers, guides anchors and supports located in crawl spaces, pipe shafts and suspended ceiling spaces are not considered exposed.

3. PART 3 - EXECUTION

3.1 INSERTS

A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4".

C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut flush with top of slab.

E. In remodeled areas, provide expanding concrete anchors. Holes for expanding fasteners to be drilled either by carbide bit or by teeth on fastener itself. Expansion shield to be "set" by driving it into hole and expanding it with conical plug.

3.2 DUCT HANGERS AND SUPPORTS

A. Duct hanging system shall be at contractor's option. Comply with SMACNA - HVAC Duct Construction Standards, Metal and Flexible and meet with approval of Engineer.

B. Vertical Ducts Through Floor Slabs: Are to be supported on two sides by galvanized steel angles bolted to duct and resting on floor slab. Supporting angles are to be bolted to floor, ceiling or wall to prevent vibration.

C. Vertical Ducts In Open Shafts: Provide additional galvanized structural steel members to span openings for support of ducts and angles at each floor.

D. Ducts Along Walls: Are to have supports spaced not more than 8 feet apart.

E. Provide hangers at the center of every ell or change in direction of horizontal ductwork.

F. Wire strap or perforated hangers will not be permitted.

3.3 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors and roofs.

B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

3.4 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves. All sleeves shall be set true to line, level, plumb and position.

B. Where ducts or pipes which pass through sleeves are to be insulated, the sleeves shall be of sufficient size to permit the full specified thickness of insulation to pass through sleeves.

C. Extend sleeves through floors 1" above finished floor level. Caulk sleeves full depth and provide floor plate. Floor sleeves in kitchen, laboratories or equipment rooms over habitable spaces shall extend 2" above finished floor.

D. Where ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk seal air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration. All pipe penetrations shall be fire-stopped as necessary to restore the original fire rating of the floor or wall system. The annular void around the pipe shall not be filled with mineral wool, fiberglass insulation, cement, grout or similar non-rated materials that fail to expand when exposed to heat.

E. Install chrome plated steel escutcheons at finished surfaces.

F. The contractor shall not drill holes through, cut or otherwise damage any beam or column of the building's structural frame.

G. Installation of Fire, Smoke and Fume Stopping Materials:

1. Penetration shall be free of debris and dirt.

2. Dam the penetration (when required) with an acceptable material.

3. Apply material to the penetration. Use a caulking gun, putty knife or other normal trade tools per manufacturer's instructions.

4. Provide proper material thickness to assure that fire rating is equal to or greater than floor or wall pipe is penetrating.

3.5 ADJUSTING AND CLEANING

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

D. Clean sleeves with fire, smoke and fume stopping materials as follows.

1. Remove damming materials where necessary after material has cured.

2. Clean up adjacent surfaces with Xylene or other approved cleaning agent.

-- END OF SECTION –

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SECTION 15250
THERMAL INSULATION

1. PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Products furnished and installed under this section:

1. Insulation.

2. Protective coverings.

3. Accessories.

4. Repairs to all existing insulation cut or damaged by work performed under this Contract.

B. Products furnished but not installed under this section: None.

C. Products installed but not furnished under this section: None.

D. Services provided:

1. Design - None.

2. Training - None.

3. Obtain permits - None.

1.2 DEFINITIONS

A. Piping Insulation: Thermal insulation applied to prevent heat transmission to or from a piping system (temperature range of -100F to +1500F).

B. Ductwork Insulation: Thermal insulation applied to prevent heat transmission to or from a duct system (temperature range of -100F to +1500F).

C. Equipment Insulation: Thermal insulation applied to prevent heat transmission to or from a piece of equipment that is part of a plumbing, heating or cooling system (temperature range of -100F to +1500F).

D. Jacket: Protective covering over insulation; may be factory applied such as "all service jacket" or field applied to provide additional protection; of such materials as canvas, polyvinyl chloride (PVC), aluminum or stainless steel.

E. Vapor Retarder Jacket: Insulation jacket material which impedes the transmission of water vapor.

F. Insert: Spacer placed between the equipment support system and the equipment to allow for the space required for insulation.

G. Insulation Shield: Buffer material placed between the equipment support system and the insulation to prevent the insulation material from crushing.

1.3 CODES AND STANDARDS

A. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.

C. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

D. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

F. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

G. Midwest Insulation Contractors Association (MICA) - Commercial and Industrial Insulation Standards.

H. North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

I. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

J. National Insulation and Abatement Contractors Association (NIACA) - Guide to Insulation Product Specifications.

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

L. NFPA-90A - Installation of Air Conditioning and Ventilation Systems.

M. NFPA-90B - Warm Air Heating and Air-Conditioning Systems.

N. ASHRAE Standard 90.1-1989 Energy Efficient Design of New Buildings Except New Low-Rise Residential Buildings.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum five years documented experience.

C. Products: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84 or NFPA 255 or UL 723.

D. No insulation product shall support or promote mold or fungus growth.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300 and Section 15010.

B. Product Data: Provide a schedule, listing each type of insulation, thickness, density, type of protective covering, etc., and the work and service to which each type of insulation is to be applied. The schedule shall be submitted in quantities consistent with that required in the Conditions of the Contract. No insulation shall be purchased or installed until the schedule is reviewed by the Engineer.

C. Manufacturer's Installation Instructions: Indicate specific installation instructions per the manufacturers of the various products and indicate how the system (combination of products) will be assembled. Highlight critical environmental factors such as drying time, etc., as well as any variations between the manufacturer's installation instructions and the specified installation instructions along with a reason for the difference.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Section 01600.

B. Deliver products to site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.

C. Protect products against dirt, water, chemical and mechanical damage before, during and after installation. Do not install damaged or wet insulation; remove from project site. Damage to products prior to final acceptance of the Work shall be repaired or replaced at no additional cost to City.

D. Where existing insulation has been removed or disturbed, due to new connections and/or alterations, repair and replace existing insulation using materials that match existing, except where existing insulation includes asbestos material.

E. Existing insulation containing asbestos materials (or thought to contain asbestos materials) must be removed by City, either totally or in part, in strict accordance with OSHA Regulations utilizing OSHA approved Contractors. Repair and/or replacement of existing insulation containing asbestos shall be with new products as specified herein.

F. Maintain ambient conditions required by the manufacturer of each product.

1.7 WARRANTY

A. One year warranty on products and complete installation commencing at the time of Substantial Completion.

1.8 MAINTENANCE

Not Applicable

2. PART 2 - PRODUCTS

2.1 INSULATION

A. Acceptable Manufacturers:

1. Owens-Corning Fiberglas
2. Knauf Fiberglass
3. Armstrong
4. Certainteed Corp.

B. Type GFP: *Glass fiber pipe* insulation; ANSI/ASTM C547, rigid molded, for use to 850F; thermal conductivity ('k' value) of 0.23 (Btu)/(hr ft^2 °F) at 75F mean temperature, k=0.29 at 200F, k=0.43 at 400F; noncombustible factory-applied white kraft paper bonded to aluminum foil and reinforced with glass fibers (ASJ) (vapor permeability shall not exceed .02 perms) that has a self-sealing longitudinal lap which provides positive closure without the use of tools, staples, adhesives, ties or tape at ambient temperatures between 25F and 110F shall be provided as a vapor retarder.

C. Type GFRB: *Glass fiber rigid board* insulation; ASTM C612; for use to 1000F; 'k' value of .28 at 75F mean temperature Class 2; 3 lb/cu ft minimum density; noncombustible factory-applied foil-scrim kraft (FSK) jacket (vapor permeability shall not exceed .02 perms). OR all service jacket (ASJ).

2.2 DUCT ACCESSORIES

A. Acceptable Manufacturers:

1. Foster

2. Minnesota Mining

3. Chicago Mastic

B. Adhesives: Waterproof fire-retardant type.

C. Lagging Adhesive: Fire resistive to ASTM E84 or NFPA 255 or UL 723.

D. Joint Tape: Glass fiber cloth, open mesh.

E. Bedding Compounds: Non-shrinking, permanently flexible, compatible with insulation.

F. Vapor Retarder Coating: Non-flammable, fire resistant, polymeric resin, compatible with insulation.

G. Insulating Cement: ANSI/ASTM C195, hydraulic setting mineral wool.

H. Impale Anchors: Galvanized steel, 12 gauge, self-adhesive pad.

I. Tie Wire: Annealed steel, 16 gauge.

J. Wire Mesh: Corrosive-resistant metal; hexagonal pattern.

3. PART 3 - EXECUTION

3.1 EXAMINATION

A. Install products only after piping, ductwork and equipment have been tested and approved.

B. Verify that surfaces are clean and dry with any and all foreign material removed.

C. Provide drop cloths or other means of protecting all equipment from drops, spattering, etc. which may be caused by the application of insulating products.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's and NAIMA instructions.

B. Whenever insulated pipes or ducts pass through sleeves or openings, the full specified thickness of the insulation shall pass through the sleeve or opening, except for sleeves located in fire rated partitions or floors. Space between pipe and sleeve located in fire rated partition or floor shall be sealed.

C. Contractor shall note that all adhesives shall be applied as specified, in continuous bands for complete coverage. The "spot" application of adhesives is not permitted.

D. Neatly finish insulation at supports, protrusions and interruptions.

E. Contractor shall coordinate with support and firestopping requirements as noted elsewhere in the Contract Documents.

3.3 APPLICATION (DUCTWORK)

A. Flexible ductwork insulation (Type GFFB) (1½" thick) shall be applied to all concealed (above ceiling, within shafts, etc.) supply ductwork.

1. Insulation shall be wrapped around and secured to ducts by means of the butt joint method of application along the duct length (longitudinal seam) and the butt joint method of application along the duct perimeter at the joints (longitudinal seam). Overlapping flap shall be at least 2" wide.

2. All edges of insulation shall be butted snugly together. Provide 4" wide tape on ducts at all joints, seams, edges, breaks, mechanical pin penetrations, etc.

3. Insulation shall be further secured to the bottom of horizontal ductwork or to all four sides of a vertical duct with approved type welded mechanical pins. These pins shall be applied on 12" centers to all surfaces of ductwork as follows:

Horizontal Duct Width	Vertical Duct Dimensions	Minimum Rows of Pins
Up to 11"	Up to 11"	No pins required
12" to 23"	12" to 23"	One
24" to 35"	24" to 35"	Two
36" to 47"	36" to 47"	Three
48" to 59"	48" to 59"	Four
60" to 71"	60" to 71"	Five
72" to 83"	72" to 83"	Six
84" to 95"	84" to 95"	Seven

4. Contractor shall install all insulation without sag.

5. All round ductwork shall be insulated same as specified above except no pins are required.

B. Rigid ductwork insulation (Type GFRB) (1½″ thick) shall be applied to:

1. All outdoor air intakes, supply fan housings and supply plenums, from the point of entry into the building to the fan or supply AHU discharge.

2. Exhaust ducts from exhaust damper to outside.

3. Insulation shall be secured to all four sides of ductwork with approved type welded mechanical pins. These pins shall be applied on 12″ centers to all surfaces of ductwork as follows:

Duct Dimension	Minimum Rows of Pins
Up to 11″	No pins required
12″ to 23″	One
24″ to 35″	Two
36″ to 47″	Three
48″ to 59″	Four
60″ to 71″	Five
72″ to 83″	Six
84″ to 95″	Seven

4. Insulation shall be secured by applying Foster No. 85-20 adhesive in 4″ wide continuous bands on 12″ centers. Press/impale insulation into place, butting all edges together snugly.

5. Contractor shall install all insulation without sag.

6. After boards are impaled, the welded pins shall be cut to extend ⅛″ beyond face of board. A self-locking cap shall be pushed onto the pin after coating with Foster No. 30-35. All insulation edges, butt joints breaks and mechanical pin penetrations shall be sealed with joint sealing tape. Tape used to seal joints at exterior corners must be 5″ wide. Tape shall be pressure sealing type requiring no separate adhesive, installed in accordance with manufacturer's instructions.

C. All 100% exhaust system ductwork shall not be insulated.

D. Insulation at access panels shall be removable with metal corner beads.

3.4 CLEANING

A. All empty cartons, containers, etc. which have contained insulating materials shall be removed from the site and premises by the Contractor as soon as possible after their contents have been removed.

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SECTION 15860
CENTRIFUGAL FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Direct Drive Centrifugal In-Line Fans.

B. Access doors.

C. Control dampers.

1.2 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

E. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

F. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

G. SMACNA - HVAC Duct Construction Standard, Metal and Flexible.

1.3 QUALITY ASSURANCE

A. Refer to General Conditions, Division 1 and Section 15010.

B. Comply with product data under provisions of Division 1, Section 01400.

C. Performance Ratings: Conform to AMCA 210.

D. Sound Ratings: AMCA 301, tested to AMCA 300.

E. Fabrication: Conform to AMCA 99.

1.4 SUBMITTALS

A. Refer to General Conditions, Division 1 and Section 15010.

B. Submit product data under provisions of Section 01300.

C. Provide product data on centrifugal fans and accessories as required for the work.

D. Provide fan curves with specified operating point clearly plotted.

E. Submit sound power levels for both fan inlet and outlet at rated capacity.

1.5 OPERATION AND MAINTENANCE DATA

A. Refer to General Conditions, Division 1 and Section 15010.

B. Submit operation and maintenance data under provisions of Section 15010.

C. Include instructions for lubrication, motor and drive replacement, spare parts list and wiring diagrams.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and protect products under provisions of General Conditions, Division 1 and Section 15010.

B. Protect motors, shafts and bearings from weather and construction dust.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Greenheck Fan Corp. Model SQ (Basis of Design)

B. Loren Cook Company

C. Penn Ventilator

D. Substitutions: Under provisions of General Conditions and Division 1, Section 01600.

2.2 DIRECT DRIVE CENTRIFUGAL IN-LINE FANS

A. Description

1. Direct drive centrifugal in-line fan in rectangular housing, location and capacity as indicated on drawings.

B. Wheel:

1. Non-overloading, backward inclined centrifugal wheel
2. Constructed of aluminum
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
5. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone.

C. Motors (Electronically Commutated Motor):

1. Motor enclosures: Open type
2. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable.
3. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
4. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
5. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
6. Motor shall be a minimum of 85% efficient at all speeds.

D. Housing/Cabinet Construction:

1. Construction material: 20 gauge galvanized steel
2. Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars
3. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.

E. Housing Supports and Drive Frame:

1. Housing supports are constructed of structural steel with formed flanges
2. Drive frame is welded steel which supports the motor

F. Disconnect Switch shall be NEMA 1 rated, provide positive electrical shut-off and wired from fan motor to junction box.

G. Duct collars shall be available to provide a large discharge area and easy duct connection.

H. Two sided access panels shall be provided and located perpendicular to the motor mounting panel to permit easy access to all internal components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated and fan has been test run under observation.

B. Install fans as specified, with resilient mountings and flexible electrical leads.

C. Install flexible connections specified in Section 15910 between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 1" flex between ductwork and fan while running. Flexible connectors shall not be in tension while running.

D. Provide fixed sheaves required for final air balance.

E. Provide isolation dampers on discharge of exhaust fans and as indicated.

3.2 FIELD INSPECTION AND REPORT

A. Provide report, in accordance with Section 01400, prepared by manufacturer's representative, stating that systems installed and services provided under this Section are in accordance with manufacturer's recommendations and are properly operating.

3.3 FAN SCHEDULE

A. Refer to drawings.

END OF SECTION

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SECTION 15890
METAL AND FLEXIBLE DUCT

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Duct and duct-associated materials and procedure in this section include:

1. Sheet metal materials
2. Single-wall rectangular ducts and fittings
3. Single-wall round ducts and fittings
4. Sealants and gaskets
5. Hangers and supports

1.2 DEFINITIONS

A. Duct Size: Duct sizes indicated herein or on associated drawings shall be the inside clear dimensions of actual air path for both unlined and lined ducts.

B. Pressure Class: A "SMACNA - HVAC Duct Construction Standards, Metal and Flexible" pressure classification system designating static pressure values (in inches w.g.) equal to the maximum operating pressure to which the ductwork can safely be subjected.

1.3 CODES AND STANDARDS

A. ASTM A 36/A 36M-97a: Specification for Carbon Structural Steel

B. ASTM A 366/A 366M-97: Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality

C. ASTM A 480/A 480M-98a: Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

D. ASTM A 653/A 653M-99a: Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

E. ASTM B 209-96: Specification for Aluminum and Aluminum-Alloy Sheet and Plate

F. ASTM C 411-97: Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

G. ASTM C 534-94: Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

H. ASTM C 916-85 (Reapproved 1996): Specification for Adhesives for Duct Thermal Insulation

I. ASTM C 920-98: Specification for Elastomeric Joint Sealants

J. ASTM C 1071-98: Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)

K. ASTM E 84-00a: Test Method for Surface Burning Characteristics of Building Materials

L. NFPA 90A-99: Installation of Air Conditioning and Ventilating Systems (ANSI)

M. NFPA 90B-99: Installation of Warm Air Heating and Air Conditioning Systems (ANSI)

N. NFPA 96-98: Ventilation Control and Fire Protection of Commercial Cooking Operations (ANSI)

O. NAIMA AH124-98: Fibrous Glass Duct Liner Standard

P. SMACNA: Duct Cleanliness for New Construction, 2000

Q. SMACNA: HVAC Air Duct Leakage Test Manual, 1985

R. SMACNA: HVAC Duct Construction Standards-Metal and Flexible, 1995 (excluding all amendments and proposed revisions).

S. UL 181-96 (Rev. 98): Factory-Made Air Ducts and Air Connectors

T. UL 723-96 (Rev. 98): Test for Surface Burning Characteristics of Building Materials

1.4 QUALITY ASSURANCE

A. Construct ductwork to NFPA 90A standards.

B. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall, at a minimum, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," excluding all amendments and proposed revisions, and performance requirements and design criteria indicated.

1. All further references to conformance with the requirements of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" shall always mean with the exclusion of all amendments and proposed revisions.
2. Where the requirements of this specification exceed the requirements of the SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," the specifications shall govern.

C. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

D. Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1.5 SUBMITTALS

A. Product Data: Submit for each type of the following products:

1. Sealants and gaskets: submit manufacturer's data sheets including performance data, pressure ratings, surface burning characteristic and installation instruction.

B. Field record drawings:

1. During the construction process, the Contractor shall maintain a set of drawings showing the exact routing and location of duct systems being installed. The drawings shall be updated neatly by hand on a daily basis and account for routing modifications made in the field. Contractor shall use these drawings as a basis for generating the project as-built drawings.

C. As-built drawings:

1. Upon completion of project, Contractor shall furnish as-built drawings showing in scale the exact routing and locations of all newly installed ductwork systems. Submit in both hard-copy and electronic AutoCAD format.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protect new duct interiors from moisture, construction debris and dust, and other foreign materials. If inside of new duct becomes dirty, Contractor shall clean duct per Duct Cleaning specifications.

B. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

1.7 WARRANTY

A. One year warranty on products and complete installation commencing at the time of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

1. Galvanized Sheet Steel: Comply with ASTM A 653. Lock forming quality with G-90 galvanized coating designation (not less than 1.25 oz. of zinc on each side of each square foot of sheet).
2. Paint Grip Steel; mill-phosphatized "Paintgrip" or "Zincgrip" finish suitable for field painting.
3. Minimum ducts gauges shall be in accordance with the following table. This table shall be used in conjunction with SMACNA table for application of appropriate reinforcement in accordance with proper pressure class.

(1) Galvanized steel - round duct:

Maximum Duct Dimension (in.)	Minimum Duct Gauge	
Up to 10	26	pressure class 2" w.g.
Up to 10	24	pressure class greater than 2" w.g.
11 thru 17	24	
18 thru 27	22	

B.

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS (FACTORY AND SHOP-FABRICATED)

A. Acceptable Manufacturers:

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Shop fabricated ducts are acceptable for all positive pressure ducts and negative pressure ducts with ratings of -1" w.g. to -4" w.g.

B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. All round ducts must utilize spiral lock seam except:

a. Ducts up to and including 12" diameter with a positive pressure class of 2" w.g. and less may utilize longitudinal lock seam construction.

C. SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, and materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse joints in ducts larger than 60" in diameter shall be flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 48" in diameter with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SEALANT AND GASKETS

A. Acceptable Manufactures for Duct Sealant:

1. Hardcast
2. United McGill
3. Ductmate

B. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

C. Duct Sealant:

1. Water-based non hardening, water resistant, mold and mildew resistant sealant classified compounded specifically for sealing joints and seams in ductwork.

a. Maximum Static-Pressure Class: 10" w.g., positive and negative.
b. Service: Indoor or outdoor.
c. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets for specific applications.

2. Duct tapes are not allowed.

D. Flanged Joint Sealant: Comply with ASTM C 920. General: Single-component, acid-curing, silicone, electrometric. Type S, Grade NS, Class 25, Use O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

1. Gaskets used in chemical, laboratory, or process exhaust duct systems shall be suitable for exposure to substances in the air stream. Contractor shall verify the compatibility with Engineer prior to installation.

2.4 HANGERS AND SUPPORTS

A. Hanger Rods for Dry or Non-corrosive Environments: Cadmium-plated steel rods and nuts.

B. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

C. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

D. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Install duct with duct material for pressure class as per the following table:

Duct System and Location	Material	Pressure Class
Exhaust system with no air terminal units: all duct	Galvanized steel (G90)	-2″
Air relief and transfer	Galvanized steel (G90)	+2″

3.2 INSTALLATION

A. General

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Where interferences develop in field, offset or reroute ductwork as required for clearing such interference.
2. Contactor shall modify specified duct sizes as required to fit. Modified duct size shall have cross-sectional area and pressure drop equivalent to that of the specified duct size.
3. All ducts shall be airtight and free from pulsation and vibration at normal operating conditions.
4. Contractor shall submit sheet metal shop drawings to the Test and Balance Contractor for review, and provide any additional volume dampers that the Test and Balancing Contractor needs to perform final balancing.
5. Install round ducts in maximum practical lengths.
6. Install ducts with fewest possible joints.
7. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
8. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
9. Install ducts with a minimum clearance of 1″, plus allowance for insulation thickness.
10. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
11. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
12. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1½″.
13. Where ducts pass through fire and smoke rated interior partitions and exterior walls, install fire, smoke, and/or combination fire/smoke dampers. Contractor shall obtain a copy of architectural drawings showing the fire and smoke rated partitions and exterior walls at the time of bid and provide the appropriate damper (at all ducts penetrating fire and smoke rated partitions and walls whether shown on mechanical plans or not). Comply with requirements in Division 15 Section “Duct Accessories” for fire and smoke dampers.

14. Provide openings in ducts where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ducts, install insulation material inside a metal ring.
15. Where ducts of different metals meet, joint shall use a gasket, seal or compound to prevent the two different metals from coming in contact.
16. Galvanized surfaces altered or damaged (including the damage due to welding) shall be painted with a galvanized paint.
17. Gaskets shall not protrude into airstream.
18. El
    a. Round Duct, excluding laboratory (fume handling) exhaust duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
        (1) Use minimum 1.5 radius-to-diameter ratio.
        (a) 12" and Smaller in Diameter: Stamped (pleated not acceptable)
        (b) 14" and Larger in Diameter: Standing seam or welded five-piece 90 degree turning elbows (three-piece elbows not acceptable for 90 degree elbow).
        (c) 45 degree elbows shall meet the requirements for 90 degree elbows and shall be die stamped up to 12" and three piece construction of sized greater than 12".
19. Offsets and transitions: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-7, "Offsets and Transitions."
    a. Transitions:
        (1) Increase duct sizes gradually, not exceeding 15 degrees on each side for a concentric transition or 30 degrees on one each side for an eccentric transition.
        (2) Decrease duct sized not exceeding 22.5 degrees on each side for a concentric transition or 45 degrees on one side for an eccentric transition.
    b. Offsets:
        (1) Provide smooth radius offset with the radius equal to the duct dimension.
        (2) Mitered offset Type 2 is acceptable provided the offset angle no greater that 15 degrees.
20. Easements for obstructions:
    a. Provide easements where ductwork conflicts with piping and structure.
    b. Where easements exceed 10% duct area, split into two ducts maintaining original duct area.
21. Seam and joint sealing:
    a. For all new ducts, all transverse joints, longitudinal seams and connections shall be sealed in conformance with SMACNA Class A

sealing requirements as defined in the 1995 SMACNA HVAC Duct Construction Standards - Metal and Flexible, Second Edition.

22. Hangers and supports: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

    a. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
    b. Support ducts using traverse steel and threaded rods or 1" wide straps of 16 gauge galvanized steel. Wire or perforated straps of any kind are not acceptable.
    c. No hangers and supports shall be attached to ducts with sheet metal screws that penetrate any part of ducts.
    d. Round duct shall be suspended on prefabricated circular single loop or two-piece bands completely encircling ducts.
    e. Hanger Spacing: Except where requirements herein exceed, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct,"
        (1) Provide duct supports at a maximum of 6 foot intervals, within 24" of each elbow, and within 24" of each branch intersection.
        (2) Provide vertical ducts supports at a maximum of 10 foot intervals.
    f. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

-- END OF SECTION --

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SECTION 15910
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Accessories addressed in this section include:

1. Manual volume dampers
2. Motorized control dampers
3. Fire dampers
4. Flexible connectors
5. Instrument test holes

1.2 DEFINITIONS

Not Applicable

1.3 CODES AND STANDARDS

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

B. AMCA 511 - Certified Ratings Program for Air Control Devices.

C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems, 2002

D. SMACNA - HVAC Duct Construction Standards-Metal and Flexible, 1995

E. UL 555 - Standard for Safety Fire Dampers, 1999

F. UL 555S - Standard for Safety Smoke Dampers, 1999.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

B. Ductwork specialties shall be designed and manufactured to conform to the same pressure class as the duct in which they are located, unless otherwise indicated to exceed.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's literature and illustrations for all components indicating materials, construction, quantities, size, dimensions and configuration.

B. Submit a request for substitution if not providing the listed Acceptable Manufacturers for any given product.

C. Shop Drawings: Provide details of equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection for all products.

D. Manufacturer's Installation Instructions: Indicate specific installation instructions per the manufacturer of all products, and indicate how the system will be assembled for:

1. Fire dampers

E. Coordination Drawings: Provide coordination reflected ceiling plans, drawn to scale showing penetrations, ceiling-mounting items, ceiling-mounting access panels and access doors required for access to duct accessories.

F. Submit operation and maintenance data under provisions of Section 15010.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Section 01600.

B. Deliver products to site in containers with manufacturer's and UL stamp affixed.

C. Protect products against dirt, water, chemical and mechanical damage before, during and after installation. Damage to products prior to final acceptance of the Work shall be repaired or replaced at no additional cost to the City.

1.7 WARRANTY

A. Provide one year warranty.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, except where otherwise indicated to exceed the requirements of the Standard.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation. For uninsulated ducts with surfaces exposed to view, provide paint grip steel; mill-phosphatized "Paintgrip" or "Zincgrip" finish suitable for field painting.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, ¼" minimum diameter for tie rod lengths of 36" or less; 3/8" minimum diameter for tie rod lengths longer than 36".

2.2 MANUAL VOLUME DAMPERS

A. Acceptable Manufacturers:

1. Air Balance, Inc.
2. Nailor Industries, Inc.
3. Ruskin Company
4. Vent Products Company, Inc.

B. Quality Assurance:

1. Include leakage, pressure drop, and maximum pressure data with submittals.
2. Damper pressure drop ratings shall be based on tests and procedures performed in accordance with AMCA500.
3. Field or shop fabricated manual volume dampers are not acceptable.

C. Standard Manual Volume Damper:

1. Factory fabricated, rectangular or round damper with required hardware and accessories. Single-blade or multiple-opposed-blade design, with linkage outside airstream, and suitable for horizontal or vertical applications.
2. Performance data:

   a. Capacity: Demonstrate damper capacity to withstand HVAC system operating conditions.

      (1) Closed position: Maximum pressure of 3″ w.g.
      (2) Open position: Maximum air velocity of 1,500 fpm.

   b. Pressure drop:

      (1) Round dampers: Maximum 0.02″ w.g. at 1,500 fpm across a 20″ diameter round damper.

3. Round Damper Construction:

   a. Frame: Minimum 0.036″ thick galvanized steel with flanges where indicated for attaching to walls.
   b. Blades: Minimum 20 gauge (0.040″ thick) galvanized steel, maximum 16″ diameter.
   c. Basis of Design: Ruskin Company Model MDRS25.

D. Jackshaft: 1″ diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

E. Damper Hardware:

1. Hand-Operated Damper Regulator:

   a. For all manual dampers provide a locking type hand quadrant operator with lever handle, position indicator and lock nut for all dampers.
   b. Provide a minimum of a 2″ hand-quadrant stand-off elevated platform where damper is located in insulated ducts.

F. Motorized Control Dampers

1. Acceptable Manufacturers:

   a. Johnson Controls
   b. Ruskin Company
   c. TAMCO (T.A. Morrison & Co. Inc.)
   d. Vent Products Company, Inc.

2. Quality Assurance:

   a. Include leakage, pressure drop, and maximum pressure data with submittals.
   b. Damper pressure drop ratings shall be based on tests and procedures performed in accordance with AMCA500.

3. Performance data:

   a. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.

      (1) Closed Position: Maximum pressure of 10 inches w.g.
      (2) Open Position: Maximum air velocity of 4,000 feet per minute.

   b. Leakage: Maximum 6 cubic feet per minute total at 1" w.g. for all sizes.
   c. Pressure Drop: Maximum 0.03 inch w.g. at air volume of 7,000 cubic feet per minute through 24 inch diameter damper.
   d. Operating Temperature Range: From -40F to 200F.

4. Damper Construction:

   a. Frame: 7 inches x minimum 20 gage galvanized steel with roll formed beads at each end.
   b. Blade: Double skin with minimum 14 gage equivalent thickness, galvanized steel.
   c. Bearings: Self-lubricating stainless steel sleeve, pressed into hole in frame.
   d. Blade Seals: Closed cell polyethylene foam rubber fully encompassing and mechanically attached to blade edge.
   e. Axle: Minimum 1/2 inch diameter, full length, plated steel, mechanically attached to blade.
   f. Mounting: Horizontal.
   g. Finish: Mill galvanized.
   h. Basis of Design: Ruskin Company Model CDRS25.

5. Damper Accessories:

   a. Actuator:

      (1) Electric: 24 V, 60 Hz, two-position.
      (2) Fail Position: Closed.
      (3) Mounting: External.

2.3 FIRE DAMPERS

A. Acceptable Manufacturers:

   1. Air Balance, Inc.
   2. Greenheck
   3. Nailor Industries, Inc.
   4. Ruskin Company

B. Quality Assurance:

   1. Comply with NFPA 90A except where specification exceeds requirements of NFPA 90A.
   2. Fire dampers shall be labeled according to UL 555.

C. Ratings:

1. Fire rating: 1½ hour and/or 3 hours as required by wall rating.
2. All fire dampers shall be dynamic type dampers. Dampers located in ductwork constructed with a pressure classification of more than ±2″ w.g. and at shaft walls shall be rated at a minimum of 4,000 fpm and 6″ w.g. All other dampers shall be rated at a minimum of 3,000 fpm and 4″ w.g. static pressure.

D. Curtain Type Fire Damper:

1. Frame: Roll formed galvanized steel, minimum of 20 gauge (0.034″ thick) with mitered and interlocking corners.
2. Blades: Roll formed galvanized steel, minimum of 24 gauge (0.028″ thick), interlocking blades.
3. Mounting Sleeve: Factory fabricated integral, minimum 20 gauge (0.034″ thick).
4. Mounting Orientation: Vertical or horizontal. Provide blade lock and stainless steel closure springs for horizontal installations.
5. Basis of Design – Ruskin DIBD2 or DIBD23, Type B or C
6. Temperature release device shall be a replaceable 165F rated fusible link.

2.4 FLEXIBLE CONNECTORS

A. Acceptable Manufacturers:

1. Duro Dyne Corp.
2. Ventfabrics, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 4″ wide attached to two strips of 2¾″ wide, 24 gauge (0.028″ thick), galvanized sheet steel or 0.032″ thick aluminum sheets. Select metal compatible with ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz/sq yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: -40F to +200F.

2.5 INSTRUMENT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General

1. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" except where otherwise noted to exceed the requirements of this Standard.
2. Provide duct accessories of materials suited to duct materials; use galvanized steel accessories in galvanized-steel, paint grip steel accessories in paint grip steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
3. Install accessories in accordance with manufacturer's instructions.

B. Manual Volume Dampers

1. Utilize standard volume dampers for:

   a. supply airflow balancing downstream of terminal units,
   b. return and exhaust airflow balancing applications further than 30 feet from the return or exhaust fan.

2. Provide manual volume dampers for balancing at all points on supply, return and exhaust systems where branch ducts are taken from larger ducts and at duct or flexible take-offs to supply and return diffusers or registers.
3. Install at a minimum of two duct widths from branch takeoff.
4. When installing volume dampers in ducts with liner; avoid damage to and erosion of duct liner.
5. When installing volume dampers in insulated duct, install regulator with elevated platform such that damper is accessible and adjustable without imparting damage to the insulation.
6. Close duct penetrations for damper components to seal duct consistent with pressure class.

C. Fire Dampers

1. Use curtain type damper where size, pressure and velocity ratings of damper allows. Where curtain type dampers are acceptable:

   a. Utilize "Type B" curtain type fire damper, with blades out of the airstream in the open position for

      (1) Supply ductwork downstream of air terminal units (VAV boxes)
      (2) Return distribution ductwork excluding return ductwork penetrating main mechanical room walls and main vertical shafts.
      (3) Toilet exhaust and general exhaust
      (4) Transfer air ductwork

2. Use multiple blade type fire dampers where damper size exceeds that available in curtain type dampers.

3. Install dampers within the fire rated barrier complete with mounting collars, retaining angles, connections to adjoining ductwork and duct access doors.

D. Flexible Connectors

1. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators. Installed width shall be not less than 4".

E. Instrument Test Holes

1. Provide duct test holes where indicated and required for testing and balancing purposes.
2. Provide only factory fabricated instrument test holes in ductwork with a pressure rating greater than 2" or less than -2".
3. Install visible above insulation.

3.2 TESTING, INSPECTIONS AND ADJUSTING

A. Manual Volume Dampers

1. Operate manual control dampers to verify full range of movement is possible. Correct any situation in which dampers cannot travel their full range of movement.
2. Adjust final positioning of manual-volume dampers as specified in Section 15990, "Testing, Adjusting, and Balancing."
3. Operate remote manual volume damper operators to verify full range of movement of operator and damper.

B. Motorized Control Dampers

1. Operate motorized control dampers to verify full range of movement is possible. Correct any situation in which dampers cannot travel their full range of movement.

C. Fire Dampers

1. Contractor shall manually test each fire damper for proper operation by removing fusible link, and repair or replace any damper that does not close completely. Owner reserves the right to observe and have the authorities having jurisdiction observe all testing and resetting of fire and combination fire and smoke dampers.
2. Provide documentation identifying dampers tested, their location and the test results.
3. Provide documentation of re-testing of any dampers that failed the first test.

-- END OF SECTION --

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SECTION 15936
AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Products covered in this section include:

1. Registers/grilles.
2. Louvers.

1.2 REFERENCES

A. ADC 1062 - Certification, Rating and Test Manual.

B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

D. ARI 650 - Air Outlets and Inlets.

E. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

F. SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

1.3 QUALITY ASSURANCE

A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate performance of louvers in accordance with AMCA 500.

1.4 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

PART 2 - PRODUCTS

2.1 REGISTERS/GRILLES

A. Acceptable Manufacturers:

1. Titus
2. Carnes
3. Hart & Cooley (Tuttle & Bailey)
4. Krueger
5. Metalaire

B. General:

1. Formed and individually adjustable blades, with ¾″ maximum spacing with friction pivot, spring or other device to set blades, vertical face, double deflection as indicated on drawings; Series 300 as scheduled and manufactured by Titus.
2. Fabricate 1¼″ border with countersunk screw mounting and gasket.
3. Fabricate of steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory baked enamel finish.

C. Wall Exhaust and Transfer Grilles:

1. Formed blades, mounted vertical or horizontal on ¾″ spacing, with single deflection as scheduled on drawings.
2. Fabricate 1¼″ border with countersunk screw mounting.
3. Fabricate of steel with 20 gauge minimum frames and 20 gauge minimum blades, with factory white baked enamel finish.
4. Where not individually connected to exhaust fans, provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

2.2 LOUVERS

A. Acceptable Manufacturers:

1. Airline Products
2. Carnes
3. Dowco
4. Krueger
5. Ruskin (Basis of Design)

B. Provide 4″ deep louvers with drainable blades on 37.5 degree slope, heavy channel frame, exterior birdscreen with ½″ square mesh for exhaust; Model ELF375DX as manufactured by Ruskin.

C. Fabricate of 6063T5 extruded aluminum frame, 6063T5 extruded aluminum blades, welded assembly. Integral gutters shall be incorporated into blades, louver head and jamb frames.

D. Louver shall have clear anodize finish with the following requirements:

1. Comply with Aluminum Association AA-C22A31. Clear anodize finish 204-R1.
2. Apply finish following chemical etching and pretreatment.
3. Minimum Thickness: 0.4 mils (0.01 mm), 30 minute anodizing process.

E. Furnish with interior angle flanges for masonry installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturers' instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features and symmetry.

C. Install grilles to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

-- END OF SECTION –

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SECTION 15990
TESTING, ADJUSTING AND BALANCING
(WORK COMPLETED BY OTHERS, CONTRACTED DIRECTLY WITH THE CITY)

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment and balancing of air systems.

B. Measurement of final operating condition of HVAC systems.

1.2 RELATED SECTIONS

A. Section 15010 – Basic Mechanical Requirements

B. Section 15860 - Centrifugal Fans.

C. Section 15890 - Ductwork.

D. Section 15910 - Ductwork Accessories.

E. Section 15936 - Air Inlets and Outlets.

1.3 REFERENCES

A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.

B. ASHRAE - 1995 HVAC Applications Handbook: Chapter 34, Testing, Adjusting and Balancing.

C. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

D. TABB - International Standards for Environmental Systems Balance.

1.4 SUBMITTALS

A. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

B. Submit test reports as a submittal under provisions of Section 15010.

C. Submit test reports under provisions of Section 15010.

D. Prior to commencing work, submit draft reports indicating adjusting, balancing and equipment data required.

E. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

F. Provide reports in soft cover, letter size, three-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

G. Include detailed procedures, agenda, sample report forms prior to commencing system balance.

1.5 REPORT FORMS

A. Submit reports on AABC National Standards for Total System Balance or NEBB forms.

B. Forms shall include the following information:

1. Title Page:

   a. Company name
   b. Company address
   c. Company telephone number
   d. Project name
   e. Project location
   f. Project Engineer
   g. Project Contractor

2. Instrument List:

   a. Instrument
   b. Manufacturer
   c. Model
   d. Serial number
   e. Range
   f. Calibration date

3. Exhaust Fan Data:

   a. Location
   b. Manufacturer
   c. Model
   d. Air flow, specified and actual
   e. Total static pressure (total external), specified and actual
   f. Inlet pressure
   g. Discharge pressure
   h. Fan RPM

1.6 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Section 15010.

B. Accurately record actual locations of balancing valves and rough setting.

1.7 QUALITY ASSURANCE

A. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section with minimum three years documented experience. Perform Work under supervision of AABC Certified Test and Balance Engineer or a NEBB Certified Testing, Balancing and Adjusting Supervisor or registered Professional Engineer.

B. Total system balance shall be performed in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance. ASHRAE - 1984 Systems Handbook and NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.8 SEQUENCING AND SCHEDULING

A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.9 PRE-INSTALLATION CONFERENCE

A. Convene a conference one week prior to commencing work of this Section.

2. PART 2 - PRODUCTS

2.1 Not Used

3. PART 3 - EXECUTION

3.1 EXAMINATION

A. Before commencing work, verify that systems are complete and operable. Ensure the following:

1. Equipment is operable and in a safe and normal condition.

2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

5. Duct systems are clean of debris.

6. Correct fan rotation.

7. Fire and volume dampers are in place and open.

8. Access doors are closed and duct end caps are in place.

9. Air outlets are installed and connected.

10. Duct system leakage has been minimized.

B. Report any defects or deficiencies noted during performance of services to Engineer.

C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

E. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.3 TOLERANCES

A. Adjust main ducts in air handling systems to ± 5% of design parameters for supply and exhaust/return systems. Adjust individual terminals and branches to ± 7.5% of design conditions for supply and exhaust/return systems.

3.4 ADJUSTING

A. Recorded data shall represent actually measured, or observed condition.

B. Permanently mark settings of valves, dampers and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by City.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return and exhaust air quantities.

B. Make air quantity measurements in ducts by pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Adjust outside air automatic dampers, outside air, return air and exhaust dampers for design conditions.

3.6 SCHEDULE

Equipment	Air Balance
Air Handling Units	X
Fans	X
Air Inlets and Outlets	X

-- END OF SECTION –

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SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes general administrative and procedural requirements for electrical installations, and shall apply to all phases of the work specified, indicated on the drawings, or required to provide for complete installation of electrical systems for this project. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:

1. Submittals
2. Record documents
3. Maintenance manuals
4. Rough-ins
5. Electrical installations
6. Cutting and patching
7. Warranties
8. Temporary
9. Coordination with local utilities

1.2 DEFINITIONS

A. The following definitions shall apply throughout the contract documents:

1. Architect/Engineer: Architect or Engineer
2. Code: All applicable local, state, and national codes - latest edition
3. Contractor: Any contractor performing work required by the Contract Documents
4. Electrical: All electrical work required by the contract documents
5. Furnish: Supply and deliver to the site ready for installation
6. Indicated: Noted, scheduled, or specified
7. Installed: Erected, mounted, secured, connected, and ready for use
8. Mechanical: All mechanical work required by the contract documents
9. Provide: Furnish, install, and connect, complete and ready for use

1.3 CODES AND STANDARDS

A. The electrical system shall comply with the following codes, and all other state, local, municipal, and national bureaus and departments which have authority over this project: anything in these contract documents notwithstanding. This shall not be construed as waiving compliance with any requirements of the plans and specifications that may be in excess of any requirements of any applicable code.

1. National Fire Protection Association (NFPA)
2. American National Standards Institute (ANSI)
3. Occupational Safety and Health Administration (OSHA)
4. Factory Mutual Research Corporation (FM)
5. Underwriters Laboratories Inc. (UL)

B. All systems and components shall be FM approved and listed and labeled by UL.

C. Where there is a conflict between the code and contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by code, but are less stringent than those specified, shall not be substituted.

1.4 QUALITY ASSURANCE

A. Workmanship: The work shall be performed by competent craftsman, skilled in the trade involved, and shall be done in a manner consistent with the NECA National Electrical Installation Standards.

B. Permits: The contractor shall familiarize themselves with all requirements regarding all permits, fees, etc. and shall comply with them. The contractor at his expense shall obtain all permits, licenses, inspections, and arrangements required for the execution of the work. All utilities shall be installed in accordance with the local rules and regulations, and the contractor shall pay all charges.

1. All permits and certificates of inspection shall be turned over to Owner prior to request for final payment.

1.5 SUBMITTALS

A. General: Follow the procedures specified in Division 01 Section 01 3300, "Submittals," and as indicated in this section.

B. Where required by other sections of this specification/project manual, the contractor shall submit shop drawings, product data, or samples to the Architect/Engineer for review through the general contractor. If no general contractor is assigned, the contractor may submit directly to the Architect/Engineer.

C. Unrequired submittals will not be reviewed. Faxed, emailed, or incomplete submittals will not be reviewed.

D. Submittals shall be numbered consecutively and referenced to the section number of the specification section.

E. For shop drawings and product data submittals, the contractor shall submit a minimum of six copies for review to the Engineer through the General Contractor. If no general contractor is assigned the submittals may be sent directly to the Architect/Engineer for review.

F. Additional copies may be required by individual sections of these Specifications.

G. Shop drawings are drawings, diagrams, schedules, and other data specifically prepared for this project by the Contractor, or any manufacturer, supplier, or distributor to illustrate some portion of the work

H. Shop drawing shall be drawn to accurate scale and adequate size to illustrate required details. Maximum sheet size shall be 30" x 42". For each shop drawing sheet larger than 11" x 17", submit one drawing on reproducible media, and one blueline or photocopied print. The Architect/Engineer's action shall be indicated on the reproducible drawing, and that drawing shall be returned to the contractor.

I. Product data are illustrations, standard schedules, performance charts, instruction brochures, diagrams, and other information furnished by the contractor to illustrate a material, product, or system for some portion of the work.

J. Samples are physical examples furnished by the contractor to illustrate materials, equipment, or workmanship, and to establish the standards by which the work will be performed.

K. All submittals shall clearly indicate proposed items, capacities, characteristics, and details in conformance with the contract documents. All equipment items shall be marked with the same item number as used on the drawings or schedules. The manufacturer shall certify capacities, dimensions, and special features required.

L. Submittals shall indicate manufacturer's delivery time for the item after review by the Architect/Engineer.

M. The Architect/Engineer shall review or take other appropriate action upon receipt of the contractor's submittals such as shop drawings, product data and samples, but only to determine conformance with the design concept of the work and the information given in the contract documents.

N. The contractor shall not be relieved of responsibility for any deviation from the requirements of the contract documents by the Architect/Engineer's review of shop drawings, product data, or samples. The Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data, or samples by the Architect/Engineer's review of those drawings.

O. No portion of the work requiring submission of a shop drawing, product data, or sample shall commence until the Architect/Engineer has reviewed the submittal. All such portions of the work shall be in accordance with reviewed submittals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Where recommended by the equipment supplier, deliver equipment in fully enclosed vans after specified environmental conditions have been permanently established in spaces where equipment is to be placed. The products accepted on the site shall be wrapped in factory packing, and shall be inspected for damage prior to acceptance.

C. Store equipment in clean, dry with non-condensing environments that are controlled within manufacturer=s ambient tolerances for non-operating equipment. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

D. Handle equipment carefully to prevent damage, breaking, and scoring. The contractor shall not install damaged units or components; replace with new.

E. Equipment furnished by others. The contractor shall be responsible for receiving, uncrating, inspecting, storing, and installing of Division 16 equipment listed as furnished by others.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTIES

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of two years after the date of substantial completion. Certain equipment shall be warranted at the time of final acceptance, or for longer periods of time as specified in those sections of the project manual.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

C. Any manufacturer's warranties concerning any item installed shall be to the benefit of Owner.

D. The contractor agrees not to void or impair or to allow any sub-contractor to void or impair any warranties regarding products or items installed as part of this project.

E. The repair of faulty workmanship shall be considered to be included in the contract.

1.9 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01, "Project Closeout." In addition to the requirements specified in Division 01, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

B. The Contractor shall prepare three Operating and Maintenance Manuals for the equipment furnished. Manuals shall be submitted to the Architect/Engineer for review and distribution to Owner within thirty (30) days prior to substantial completion of the project. The Architect/Engineer may reject manuals not meeting the following requirements:

1. Each manual shall be assembled in a three-ring binder with a hard cover and plastic finish. Binders shall not exceed 3" thick. Where more than one binder is required, the manuals shall be separated into logical groupings. Where loose-leaf inserts are used, the sheets shall be reinforced to prevent tearing from continuous usage. Each binder shall have the following information clearly printed on its cover:

   a. Project name and address.
   b. Portion of the work covered by each volume (if more than one volume is in the set). Where more than one volume is required, label each volume as "Volume ___ of ___."
   c. Name, address, and telephone number of the Contractor and all Sub-Contractors including night and emergency numbers.

2. The manual shall include, but shall not be limited to, the following:

   a. A complete index.
   b. Names, Addresses, and Telephone Numbers: The list shall include the manufacturer and local representative who stocks and furnishes repair parts for all items of equipment and shall be typed on a single page in the front of the binder.

c. Start-Up, Operation, and Shutdown Procedures: Provide a written description of procedures for start-up, operation, and shutdown procedures for each electrical item or system. This description shall include switches to operate, buttons to push, etc., in proper sequence, and locations of buttons and switches. The description shall include item references or labels used in the contract documents unless otherwise instructed in advance by Owner.

d. Equipment Accessory Schedule: Upon completion of the work, the Contractor shall furnish Owner with a complete equipment accessory schedule listing each piece of equipment and the related size, type, number required, and the manufacturer of all renewable items.

e. Manufacturer's Operation and Maintenance Manuals and Parts List.

f. Emergency Procedures: Provide a written description of emergency operating procedures or a list of service organizations (including complete business address and telephone numbers) capable of rendering emergency services to the various parts of the system.

g. One copy of all shop drawings and product data, clearly marked for each item furnished using the designation label specified or indicated on the contract documents.

h. All manufacturers' warranty information.

i. Normal Maintenance Schedule: Include a listing of work to be performed at various time intervals (e.g., 30, 90, 180 days, yearly).

1.10 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of ¼" = 1'-0" or larger, detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:

   a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance

   b. Exterior wall and foundation penetrations

   c. Fire-rated wall and floor penetrations

   d. Equipment connections and support details

   e. Sizes and location of required concrete pads and bases

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communications systems components, sprinklers, and other ceiling-mounted devices.

1.11 RECORD DOCUMENTS

A. Contractor shall keep an up-to-date set of "as-installed," "red-lined" drawings kept current on a daily basis. Such drawings shall be available to Owner, Engineer, or Owner's representative at the job site at all times.

B. Upon completion of the contract, send to the Architect/Engineer, through the general contractor, one complete set of red-lined drawings showing all deviations.

C. In addition to the requirements specified in Division 01, indicate on the marked up drawings additional information for:

1. Major raceway systems, size and location, for both exterior and interior.
2. Locations of control devices
3. Distribution and branch electrical circuits
4. Switch, fuse, and circuit breaker size and arrangements
5. Equipment locations (exposed and concealed), dimensioned from prominent building lines
6. Approved substitutions, Contract Modifications, and actual equipment and materials installed

1.12 SITE EXAMINATION

A. Visit the site prior to submitting bids, examine the premises, and make a thorough survey of the conditions under which the installation is to be made.

B. The submission of a proposal will be construed as evidence that such an examination has been made, and later claims for labor, equipment, or materials required for difficulties encountered which could have been foreseen had such an examination been made, will not be recognized.

1.13 INTERPRETATION OF THE DOCUMENTS

A. Carefully compare the drawings and specifications, checking measurements and conditions under which this installation is to be made.

B. The interpretations of the intent of the plans shall rest solely with the Architect and the Architect's decision shall be considered final.

C. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect/Engineer for clarification. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date. Verbal interpretation or explanation, not issued in the form of an addendum, shall not be considered part of the bidding documents. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.

1.14 ELECTRICAL SERVICE DISRUPTIONS

A. No electrical service disruptions may occur without permission of Owner.

B. Submit a written request for any work electrical outages before taking any operating electrical equipment out of service. Any work involving a task, which requires an electrical service disruption to any part of this facility, shall be closely coordinated with Owner prior to the disruption. All disruptions shall occur at times and of durations acceptable to Owner.

1.15 OVERTIME WORK

A. Construction work shall be done during regular working hours on regular working days unless specifically noted otherwise on the drawings, and as required by Owner. If overtime work, other than specified, is required on the project, it shall be performed as indicated under the special conditions of these contracts.

B. Pricing for required overtime work specified shall be included in the Base Bid.

C. Items requiring overtime work are:

1. Exposing any energized bus
2. Any work above, below, or adjacent to active, operating equipment that must remain in operation during normal hours
3. Replacement or modification to electrical service and distribution to the facility

1.16 SAFETY

A. The contractor shall take all steps necessary to ensure the safety of the occupants, students, Owner's employees, visitors, project related personnel, or any other authorized personnel, as well as their own forces, by adequately protecting any exposed energized cable, equipment, or devices throughout the course of this work.

B. Comply with NFPA 241 for safeguarding during construction and alteration operations. In addition, any openings in fire-rated separations between occupied and unoccupied (or operational and non-operational) areas shall be sealed at the end of each work day with an appropriate fire-rated enclosure or sealant. Do not compromise existing security or fire alarm systems serving the occupied or operational areas.

1.17 INTERFERENCE WITH OCCUPANCY

A. If the existing building is occupied, then the work covered by these documents shall be executed with a minimum of inconvenience to the building occupants.

1.18 DAMAGE TO OTHER WORK

A. This contractor shall be responsible for damage to other work caused by this installation. Patching and repairing of damaged work done by this Division shall be part of the cost of this Division.

1.19 LAYOUT OF WORK

A. Layout work to be installed in coordination with other trades engaged on this project whenever their work is likely to affect the electrical installation. Be fully responsible for all dimensions and conflicts between this work and that of other trades, and make the necessary changes in the work without additional cost to Owner if the work does not comply properly with these requirements.

B. Compare contract documents with those of other trades before proceeding with the installation. Electrical wiring, conduits, or electrical equipment which has been installed without checking for interference and without thorough coordination with other trades shall be moved or relocated without additional expense to Owner.

C. Equipment shall be installed with ample space allowed for removal, repair, or change to the equipment. Ready accessibility to removable parts or equipment and to the wiring shall be provided without moving other equipment which is installed or which is already in place.

1.20 OPERATING TRAINING

A. Complete operating training for each system and item of equipment shall be provided to the Owner's designated personnel. The Operation and Maintenance Manuals must be reviewed and accepted by the Architect/Engineer and provided to the Owner prior to operating training. Training sessions shall consist of two 8-hour periods and shall be scheduled at the convenience of Owner. Training shall include instructions on the following:

1. Start-Up and Shutdown Procedures
2. Emergency Operation
3. Periodic Maintenance
4. Safety

B. In addition to the instructions required above, wherever possible the Contractor shall perform the operation being described in order to fully illustrate system operation.

C. At the completion of training, the Contractor shall turn over to Owner all required keys and special tools for the installed equipment. Each key or tool shall be labeled with its use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Unless otherwise specified, all materials and equipment shall be new, unused, and undamaged. Materials and equipment shall be the current and standard designs of manufacturers regularly engaged in their production.

2.2 MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

A. Where materials and equipment are indicated as furnished by others and installed or connected under this contract, it shall be the Contractor's responsibility to verify installation details prior to proceeding with work.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.2 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
4. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the space.

5. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
6. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
7. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
8. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
9. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.3 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01, "Cutting and Patching." In addition to the requirements specified in Division 01, the following requirements apply:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
   a. Uncover Work to provide for installation of ill-timed Work.
   b. Remove and replace defective Work.
   c. Remove and replace Work not conforming to requirements of the Contract Documents.
   d. Remove samples of installed Work as specified for testing.
   e. Install equipment and materials in existing structures.
   f. Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.
2. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
6. Patch existing finished surfaces and building components using new materials matching existing materials and experienced installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

7. Patch finished surfaces and building components using new materials specified for the original installation and experienced installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

3.4 TEMPORARY LIGHTING POWER, AND FIRE ALARM

A. Work Included

1. Electrical Contractor shall furnish and install temporary lighting, power, and fire alarm devices for this project as required and remove same at the end of the project.
2. Contractor shall install the above mentioned temporary services in a safe and workmanlike manner.
3. Provide temporary lighting and power as required in areas undergoing work during construction. Furnish and install one OSHA-approved pigtail socket with 150W lamp for every 500 square feet of floor space and a minimum one per room. The temporary lighting shall be left in place until permanent lighting is completely operational.
4. Furnish and install power outlets to a total one for every 2,000 square feet or part thereof of floor area. These shall be 15 amp, single phase receptacles for either 110 or 220 V as directed by the General Contractor. Coordinate for additional temporary power requirements with other trades and provide an adequate installation.

B. Contractor to coordinate temporary services with the following:

1. General Contractor
2. Mechanical Contractor
3. Owner/Owner Representative

3.5 COORDINATION WITH LOCAL UTILITIES

A. Utility Power Coordination

1. The Contractor shall perform all coordination and scheduling of local utility power company work effort. Any excess facilities charges will be paid by Owner without mark-up. Contractor shall provide all work required for the new service as shown on the electrical drawings.

B. Local Telephone Provider

1. The Contractor shall coordinate the installation of the local telephone system into the building with the local service provider, including the scheduling of their work effort.

END OF SECTION

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SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Scope: The work specified in this section includes, but shall not be limited to, providing labor, material, equipment and services necessary for electrical work as shown on the drawings and as herein specified.

B. Section Includes: The work specified in this section includes, but shall not be limited to, providing the following:

1. Motor and Equipment Connections
2. Sleeves and Openings
3. Coring, Cutting, and Patching
4. Fire stopping
5. Electrical Identification
6. Hangers and Supports
7. Equipment Bases
8. Electrical Utility Services and Metering
9. Demolition
10. Warning Signs

1.2 DEFINITIONS

Not Applicable

1.3 CODES AND STANDARDS

A. The electrical system shall comply with the following codes, and all other state, local, municipal, and national bureaus and departments which have authority over this project: anything in these contract documents notwithstanding. This shall not be construed as waiving compliance with any requirements of the plans and specifications that may be in excess of any requirements of any applicable code.

1. National Fire Protection Association (NFPA)
2. American National Standards Institute (ANSI)
3. Occupational Safety and Health Administration (OSHA)
4. Factory Mutual Research Corporation (FM)
5. Underwriters Laboratories Inc. (UL)

B. All systems and components shall be FM approved and listed and labeled by UL.

C. Where there is a conflict between the code and contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by code, but are less stringent than those specified, shall not be substituted.

1.4 QUALITY ASSURANCE

A. Contractor's Quality Assurance Responsibilities: The Contractor shall be solely responsible for quality control of the work.

B. Manufacturer's Qualifications: Firms shall be engaged in the manufacture of products and materials of types and sizes required, and whose products have been in satisfactory use in similar service for not less than five years.

C. Contractor's Qualifications: Firms shall have at least five years of successful installation experience with projects utilizing products and materials similar to that required for this Project.

D. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and Municipal authorities having jurisdiction. Obtain approvals from such authorities.

E. Installation: Comply with NECA National Electrical Installation standards for electrical construction methods.

1.5 SUBMITTALS

A. General

1. Submittals shall include, but shall not be limited to, equipment specifications sheets, schematic diagrams, wiring diagrams, sizes, mounting details (with required elevations), technical descriptions of components, and proper calculations to ensure specified performance of the systems.
2. Submittals shall be required for the following products listed in this specification:
   a. Utility Service Equipment
3. See Division 26 Section 26 0500, "Basic Electrical Requirements" for additional submittal requirements.

B. Product Data: Submit manufacturer's product information showing material proposed. Submit sufficient information to determine compliance with the drawings and specifications.

C. Shop Drawings: Submit complete shop drawings as required to determine acceptability.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products and materials properly packaged in factory fabricated containers and mounted on shipping skids.

B. Store products and materials in clean, dry, heated space. Protect from dirt, fumes, water, construction debris, and traffic. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle products and materials carefully to prevent internal damage, breakage, denting, and scoring enclosure finish. Do not install damaged products or materials. Replace and return damaged products or materials to manufacturer.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of two years after the date of substantial completion. Certain equipment shall be warranted at the time of final acceptance, or for longer periods of time as specified in those sections of the project manual.

B. The contractor shall repair or replace, at no additional cost, to Owner, any item that may become defective within the warranty period.

1.9 MAINTENANCE

Not Applicable

1.10 PROJECT CONDITIONS

A. Field Measurements: Verify that field measurements are as indicated on the shop drawings and as shown on the drawings.

B. Project Location Environment. Furnish and install materials suitable for the altitude, weather, and seismic requirements of the project location.

1.11 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate electrical service connections to components furnished by utility companies.

1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.1 QUALITY

A. Electrical equipment, devices and associated materials used on this project shall be UL listed and/or labeled.

B. Equipment and devices installed under this division and not constructed with enclosure suited for mounting and protecting all live parts shall be installed in approved metal cabinets.

2.2 MOTORS

A. All motors will be furnished and installed under other sections of the specification.

B. All motors shall be connected under this section.

1. Final connection shall be made with suitable length of Liquidtight flexible metallic conduit.
2. All motors shall be grounded with green grounding conductor as required.

C. Electrical characteristics of motors shall be as follows:

1. Motors ¾ horsepower and larger shall be rated for operation at 480 volts, 3 phase, 60 Hertz.
2. Efficiency: Furnish Premium Efficient motors, as defined in NEMA MG-1(2006) Table 12-12 for 200 horsepower motors.

2.3 ELECTRICAL IDENTIFICATION

A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.

1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
2. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is over laminated with a clear, weather- and chemical-resistant coating.
3. Color: Black letters on orange background.
4. Legend: Indicates voltage.

C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1" wide by 3 mils thick (25 mm wide by 0.08 mm thick).

D. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:

1. Not less than 6" wide by 4 mils thick (150 mm wide by 0.102 mm thick)
2. Compounded for permanent direct-burial service
3. Embedded continuous metallic strip or core
4. Printed legend that indicates type of underground line

E. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

F. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

G. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1⁄16" (1.6-mm) minimum thickness for signs up to 20 in^2 (129 cm^2) and ⅛" (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background for normal systems and white letters on red background for emergency systems.

H. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.

I. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396" (1-mm), galvanized-steel backing, with colors, legend, and size appropriate to the application. ¼" (6-mm) grommets in corners for mounting.

J. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers. Self adhesive backing alone is not allowed.

2.4 HANGERS AND SUPPORTS

A. Surface Mounted Cabinets: Secure cabinets directly to wall using suitable wall anchors, or provide a suitable frame for mounting and supporting the cabinets using "Unistrut" type supports as required.

B. Free Standing Motor Starters and Safety Switches: Provide suitable "Unistrut" racks with sheet steel mounting plates for this equipment.

C. Hanger Rods:

1. Provide hanger rods of proper length for electrical items requiring same
2. Minimum rod diameter shall be ⅝" for cable trays, and racks supporting more than 8" of total conduit diameter
3. Hanger rods shall be zinc plated or galvanized steel

D. Cable Supports: Riser cables shall be supported by means of O.Z./Gedney Co, Thomas and Betts, or Joslyn cable supports at each panel and pull box in accordance with Code requirements.

E. Conduit Supports and Hangers:

1. Individually suspended conduits shall be supported with galvanized pipe clamps, from threaded steel rods, spaced 5'-0" on centers.
2. The steel rods shall be affixed to the building structure by means of inserts in concrete slab or beam clamps affixed to the steel structure.
3. Where multiple conduits are installed adjacent to each other, a trapeze hanger consisting of galvanized P-l000 unistrut suspended from at least two threaded steel rods, shall be used. The conduits shall be affixed to the unistrut with galvanized split pipe clamps, Nos. P-1109 through P-1126, for rigid conduit and Nos. P-l425 through P-1431, for EMT.
4. Hangers and clamps shall be as manufactured by Unistrut, B-Line or as approved by Engineer.

2.5 EQUIPMENT BASES

A. The Contractor shall provide concrete pedestals, bases, pads, curbs, anchor blocks, anchor bolts, slab inserts, hangers, channels, cradles, saddles, etc., for installation of equipment and apparatus shown on the drawings.

B. Concrete pads shall be 4" (102 mm) high, unless otherwise indicated, complete with steel reinforcing and necessary bolts, anchors, etc. Where concrete pad is set directly on concrete floor, provide dowels in floor to tie base to floor. These pads shall be extended at least 4" (102 mm) beyond the equipment outlined on all four sides.

C. Provide concrete as required to install electrical work.

1. Concrete mix shall conform to the requirements of Division 03, "Cast-in-Place Concrete," however, if no specification is available, the mix shall not be less than 3,500 psi (20 684 kPa) metal reinforced. Pad shall be level to ⅛" per 3' in any direction.

2.6 EQUIPMENT TOUCH-UP PAINT

A. The Contractor shall provide the types and brands furnished by manufacturers for all components. Furnish a minimum of one (1) gallon of the manufacturer's paint for future touch up painting to the Owner.

B. Repair damage to factory applied paint finishes with the appropriate touch-up paint.

2.7 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

B. Meter Sockets: Comply with requirements of electrical power utility company.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Examination

1. The contractor shall visit the site and examine areas under which the work is to be performed and notify the Owner in writing of any conditions detrimental to the proper and timely completion of the work. Contractor shall not proceed with work until satisfactory conditions have been corrected.
2. Verify field measurements and circuiting arrangements for devices shown on drawings.
3. Demolition drawings are based on casual field observation and existing record drawings. Report discrepancies to Owner before disturbing existing installation.
4. Commencement of demolition means acceptance of existing conditions.

B. Preparation

1. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
2. Coordinate utility service shut-down with the utility company.
3. Notify the Owner at least 48 hours before disabling any electrical system.
4. Provide temporary wiring and connections to maintain existing systems in service during construction. Experienced personnel shall be used when working on energized equipment or circuits.
5. Existing electrical service: maintain existing system in service until new service is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
6. Maintain existing fire alarm system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner at least 48 hours before partially or completely disabling system. Where fire alarm devices must be removed to accommodate the removal of walls, notify the Owner and Engineer in writing with locations of devices.

C. Demolition and Extension of Existing Electrical Work

1. Remove, relocate, and extend existing electrical work as indicated on the drawings and as noted herein.
2. Remove abandoned wiring back to source of supply.
3. Where source of supply is a panelboard, re-label protective device as "Spare." After demolition is complete, submit revised panelboard schedules indicating "Spares" to Owner and Engineer.
4. Remove exposed abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors and patch surfaces.
5. Remove and disconnect abandoned outlets and associated devices.
6. Disconnect and remove abandoned panelboards and distribution equipment.

7. Disconnect and remove electrical devices and equipment that is no longer in use.
8. Disconnect and remove abandoned lighting fixtures. Remove brackets, stems, hangers, and other accessories.
9. Repair adjacent construction and finishes damaged during demolition and extension of work

D. Cleaning, Repair, and Replacement

1. General: Clean and repair existing materials and equipment that will remain or are to be reused.
2. Panelboards: Clean exposed surfaces and tighten all electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed schedule showing revised circuiting information.
3. Lighting fixtures: Remove existing lighting fixtures for cleaning. Use mild detergent to clean exterior and interior surfaces, rinse clean with clean water, and wipe dry. Replace existing lamps and ballasts with new.

E. Disposal

1. Owner shall have right to retain any equipment or materials that have been demolished prior to disposal or removal from site.
2. Any equipment or materials not wanted by the Owner shall become the property of the contractor and removed from site.
3. Contractor shall comply with environmental laws and regulations for disposal of demolished materials and equipment.

3.2 MOTOR CONNECTIONS AND INSTALLATIONS

A. Building utility motors such as fans, etc., and certain starting and controlling equipment for same, as indicated on the drawings, will be furnished under Division 20 or 23 of the specifications for the mechanical work and delivered to the building site.

B. Motors which are delivered to the building site independent of their driven equipment shall be set, aligned, and secured under Division 20 of the specifications.

C. Motors and electrical apparatus which are delivered to the building site factory set, assembled and attached to their driven machinery or apparatus:

1. The machinery or apparatus will be moved into position along with its attached electrical apparatus under the responsible mechanical trade section of the specifications.
2. The necessary line side electrical connections shall be provided under this section of the specifications. Furnish all labor and material to place all necessary electrical equipment in satisfactory operating condition.

D. Furnish all branch circuits for motors to the starting equipment and then to the motors, complete with control wiring for automatic and remote control where required. Conduits to motors shall terminate in the conduit fittings on the motors, the final connection being made with short length of flexible conduit. Motors shall be bonded with a green equipment grounding conductor.

E. Consult the specifications for the various branches of the mechanical work and ascertain the exact requirements of the various systems of automatic control. Install and connect up same to leave in satisfactory operating condition.

F. Provide all necessary labor and material to completely connect all ventilation equipment including motors, controls, etc., including all alarm and shutdown systems, as specified here and in the mechanical section.

G. The temperature control panel and components shall be provided under Division 23 of the specifications, including the connection of electrical items. Provide adequate slack wire for this purpose as required.

3.3 PHASE SEQUENCE, ROTATION AND IDENTIFICATION

A. Transformers, switchgear, feeders, panelboards, motor branch circuits, etc., shall be completely phased out for sequence and motor rotation. Phase identification shall be permanently identified in all equipment including conductors by use of all temperature adhesive markers or colored tape similar to Minnesota Mining #35 vinyl tape or as approved.

B. Phase sequence shall be A-B-C (viewed from front):

1. Left to right
2. Top to bottom
3. Front to rear

3.4 SLEEVES AND OPENINGS

A. Provide openings and sleeves in walls and floor as required for this work.

B. Sleeves shall be galvanized steel conduit or schedule 40 black steel pipe, unless otherwise noted. Aluminum conduit shall not be used.

C. Unless specific sizes are indicated on the drawings, sleeves shall be sized to provide ½" clearance around outside surface of the item for which they are installed.

D. Annular space between sleeve and surface of item protruding shall be suitably provided with fire stop as hereinafter specified.

E. Sleeves shall be cut flush with wall surfaces and shall extend 1½" above finished floors unless otherwise indicated.

3.5 CORING, CUTTING, AND PATCHING

A. Necessary coring or cutting in walls, floors, and ceilings shall be neatly and carefully done and repaired in an approved and workmanlike manner.

B. No cutting into the structural work of the building shall be done without the approval of the Engineer/Architect.

3.6 FIRE STOPPING

A. Provide fire and cold smoke stopping construction, as specified, for all through penetrations in rated fire construction (and smoke barriers) in accordance with UL fire resistance directory under categories XHCR and XHEZ. These guides have specific requirements for core and opening sizes based on the size of the penetrating item.

B. Fire and smoke stopping compounds shall be by 3M, or approved equal.

C. Conduit penetrations through fire rated gypsum and concrete construction shall be filled with 3M Fire Barrier CP 25WB+ Caulk according to UL and 3M guides.

3.7 ELECTRICAL IDENTIFICATION

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Identify raceways and box covers with color banding or painting as follows:

1. For all EMT conduits sizes ¾″ to 2″ nominal size, provide the distinctive color conduit identification listed below:
   a. Red – Fire Alarm System
   b. Orange – Life Safety System
   c. Yellow – Nurse Call
   d. Green – Grounding System
   e. Blue – Communications/Telephone
   f. Purple – Security Systems
   g. White – Critical Power Systems
   h. Silver – All other systems, with color codes identification listed below
2. Painting: For silver conduits and conduits above 2″ nominal size, paint conduits with identifying colors listed below. Make each color band 2″ (51 mm) wide, completely encircling conduit.
3. Bands: Pre-tensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2″ (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
4. Conduit Band Locations: At changes in direction, at penetrations of walls and floors, at 20′ maximum intervals in straight runs, and at 10′ maximum intervals in congested areas.
5. Junction Boxes and Pull Boxes: Paint only the outside of boxes and covers, with the identifying color.
6. Colors as follows:

Krylon Cat. #	Color	Raceway System
	No Color	120/208V Normal Power
52411	Pumpkin Orange	Life Safety Emergency
51501	Gloss White	Critical Emergency System
51608	Smoke Gray	Equipment System
51510	Gold	480/277 Volts Normal Power
52016	Emerald Green	Ground
52108	Banner Red	Fire Alarm Systems
52108/51910	Scarlet Red/Regal Blue (Stripe)	Voice Command Systems
52108/53540	Scarlet Red/Bahama Sea (Stripe)	Duct Smoke System
52108/53354	Scarlet Red/Ballet Slipper (Stripe)	Door Holders & Dampers
52108/51501	Scarlet Red/Glossy White (Stripe)	Tamper Valve System
51910	Regal Blue	Communications/Telephone
53532	Tomato	Code Blue Emergency Alarms
51013	Purple	Security Alarms
53540	Bahama Sea	HVAC Controls
53354	Ballet Slipper	Signal Alarms
51806	Sun Yellow	Nurse Call Systems
53540	Sweet Cream	Patient Monitoring

E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

F. Color-code 208/120V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Black
2. Phase B: Red
3. Phase C: Blue
4. Neutral: White
5. Equipment Ground: Green

G. Color-code 480/277 V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Yellow
2. Phase B: Brown
3. Phase C: Orange
4. Neutral: Gray
5. Equipment Ground: Green

H. For conductors not manufactured with integral color, use conductors with black insulation or jacket and then use color coding tape at intervals not exceeding 5', and at all terminations and splices.

I. Install engraved-laminated emergency-operating signs with white letters on red background with minimum ⅜" (9 mm) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

J. Provide identification and markings for various items furnished and installed under this division of the specifications as follows:

1. White Phenolic nameplate with black cut letters ⅜" high:
   a. Disconnect switches and individually mounted starters with number or designation of equipment served
   b. Panelboards: Identification on the outside of the cabinet door
   c. Switchboards & Switchgear: Name, sections, breaker and switch designations
   d. Individual starter housing
   e. Transformers
   f. Non-emergency transfer switches
   g. Remote Status Panels
2. White Phenolic nameplate with black cut letters ⅛" high:
   a. Pilot light identification
   b. Toggle switch identification
   c. Hand-Off-Auto selector switch identification
3. Red Phenolic nameplate with white cut letters ⅜" high:
   a. Fire Alarm Equipment
   b. Emergency Generator and Transfer Switches
   c. UPS

4. Dymo Tape labels:
   a. Light fixtures
   b. Light Switches
   c. Receptacles
   d. Disconnects
   e. Where otherwise specifically indicated

K. Voltage characteristics shall be indicated on each piece of equipment, and at each panel.

L. All panelboards shall be provided with a typed panel board schedule. Include source of power (upstream panel source and breaker or switch).

M. For special ground systems (such as telecommunication facility grounding) provide engraved brass nameplates for all ground conductors at both terminations.

3.8 WARNING SIGNS

A. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

B. Provide "DANGER - 480 VOLTS" warning signs on all 480 volt equipment.

C. Flash Protection Warning Signs

1. The electrical contractor shall provide all flash protection warning signs as required by the NEC Article 100.16. Warning signs shall conform to the requirements of NFPA 70E.
   a. All electrical equipment such as switchboards, panelboards, control panels, meter socket enclosures, and motor control centers, that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electrical hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.
   b. All warning signs MUST be installed before owner's personnel are trained on the use of the equipment.

END OF SECTION

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SECTION 16060
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Scope: The work specified in this section includes providing labor, material, equipment, and services necessary for a complete grounding system as shown on the drawings and as herein specified.

B. Grounding Section Includes: The work specified in this section includes, but shall not be limited to, providing grounding of the following:

1. Underground metal water piping
2. Underground metal structures
3. Metal building frames
4. Electrical power systems
5. Electrical metallic raceways
6. Service entrance equipment
7. Metal enclosures
8. Lighting fixtures
9. Equipment requiring power
10. Transformer secondaries
11. Telecommunications systems

C. Bonding Section Includes: The work specified in this section includes, but shall not be limited to, providing bonding of the following:

1. Interior metal piping systems
2. Medical gas and vacuum systems
3. Natural gas piping
4. Metallic waste, vent, and drain piping
5. Swimming pools

1.2 DEFINITIONS

Not Applicable

1.3 CODES AND STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. If the referenced publications have been revised prior to Contract award, the latest edition/revision shall be submitted for the referenced document.

C. ASTM International (ASTM)

1. ASTM B 8 – "Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft"
2. ASTM B 33 – (Revised 1985), "Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes"

D. Institute of Electrical and Electronics Engineers (IEEE)

1. ANSI/IEEE 80 – "Guide for Safety in AC Substation Grounding" (copyrighted by IEEE, ANSI approved)

2. ANSI/IEEE 81 – "Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System" (copyrighted by IEEE, ANSI approved)
3. ANSI/IEEE 142 – "Recommended Practice for Grounded of Industrial and Commercial Power Systems" (copyrighted by IEEE, ANSI approved)

E. Insulated Cable Engineers Association (ICEA)

1. ICEA 5-68-516 – "Ethylene Propylene Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy"

F. National Fire Protection Association (NFPA)

1. NFPA 70 – "National Electrical Code (hereinafter referred to as NEC).
2. NFPA 780 – "Installation of Lighting Systems"

G. Underwriters Laboratories, Inc. (UL)

1. UL ECMD – "Electrical Construction Materials Directory"
2. UL 467 – "Grounding and Bonding Equipment"
3. UL 486A – "Wire Connectors and Soldering Lugs for Use with Copper Conductors, Seventh Edition"

H. American National Standards Institute, Electronic Industries Alliance/Telecommunications Industry Alliance (ANSI/EIA/TIA), ANSI/EIA/TIA-607 Grounding and Bonding.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms shall be engaged in manufacture of grounding and bonding products, of types, sizes required, and ancillary grounding materials, including stranded cable, copper braid and bus, grounding electrodes, and bonding jumpers, and whose products have been in satisfactory use in similar service for not less than five years.

B. Installer's Qualifications: Firms shall have at least five years of successful installation experience with projects utilizing grounding systems similar to that required for this Project.

C. Compliance: Comply with applicable local electrical code requirements, NEC, ANSI/IEEE 142, and applicable UL requirements.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product data showing material proposed. Product data shall include, but shall not be limited to, the following:

1. Conductors
2. Cables
3. Bus bars
4. Insulators
5. Connectors
6. Ground rods

B. Shop Drawings: Submit complete shop drawings as required to determine acceptability. Shop drawings shall consist of a complete list of materials, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instruction. Shop drawings shall include, but shall not be limited to, the following:

1. Special fabricated components, which are not a manufactured standard product.

C. Proof of Compliance: Where materials or equipment are specified to comply with requirements of UL, proof of such compliance shall be submitted.

D. Test Reports: Submit ground testing test report as specified.

E. Operation and Maintenance Manuals: Prepare and deliver complete operating and maintenance manuals. Provide information pertinent to the equipment for preventive maintenance and for replacement of expendable components. Manuals shall include the items listed below and other information recommended by the manufacturer:

1. Cables
2. Bus bar
3. Insulators
4. Complete list of parts with reordering numbers
5. Electrical characteristics of components
6. Recommended spare parts list
7. Complete set of shop drawings

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Materials and components shall be properly packaged, stored, and handled to prevent damage or breakage.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion. Certain equipment shall be warranted at the time of final acceptance, or for longer periods of time as specified in those sections of the project manual.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

C. The repair of faulty workmanship shall be considered to be included in the contract.

1.9 MAINTENANCE

Not Applicable

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work, include, but shall not be limited to, the following:

1. Adalet-PLM Division; Scott Fetzer Co.
2. Burndy Corporation
3. Cadweld Division; Erico Products, Inc.
4. Crouse-Hinds Division; Cooper Industries
5. Joslyn Corporation

6. OZ Gedney Division; General Signal Corp.
7. Thomas and Betts Corp.
8. Eritech; Erico Products, Inc.

2.2 CONDUCTORS

A. General: Grounding and bonding conductors shall be bare and insulated copper as shown on the drawings or required by other sections of this specification.

B. Conductivity: Copper conductors shall have a conductivity of not less than 98 percent at 75 degrees C. Conductor resistance values shall be in accordance with the value in ICEA S-68-516.

C. Cable Sizes: Cable sizes shall be as shown on the drawings or as required by this specification.

D. Insulation: Insulated grounding and bonding conductors shall have an insulation equal to the current carrying conductors.

2.3 GROUND RODS

A. Ground rods shall be copper-clad with a minimum of 10 mil thickness of copper bonded to a steel core.

B. Rod shall be non-rusting and shall not be covered with enamel or a non-conducting coating.

C. Size shall be ⅝″ diameter by 10 feet length or as shown on the drawings.

2.4 GROUND BUSES

A. General: Ground buses shall be solid copper, ¼″ by 2″ or ¼″ by 4″ rectangular cross section and the length as shown on the drawings.

B. Isolators: Provide ground bus isolators for isolating ground bus from structures and walls. Isolators shall support ground bus a minimum of 1″ from the mounting strap attached to the wall or structure.

2.5 CONNECTORS

A. Exothermic Welds: Exothermic welds shall be a thermite reaction system employing copper oxide and aluminum powder reaction to melt and fuse copper conductors into welded connections.

B. Ground Rod-to-Cable Connector: Connector shall be U-bold ground rod clamp. A ground rod clamp shall be bronze with stainless steel U-bolt. The connector shall have at least 1½″ of contact with the ground rod and cables and accommodate at least two cables thru size No. 4/0.

C. Metal Pipe Connectors: Connectors shall be copper alloy, U-bold type.

D. Ground Bushings: Bushings shall be malleable iron, zinc plated, insulated throat with screw type wire connector.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which the work is to be installed, and notify the Architect/Engineer in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 COORDINATION

A. Coordinate with other work to ensure that installation is not vulnerable to physical damage.

3.3 APPLICATION

A. General: The entire electrical system and building structure shall be grounded. The following items of equipment, appurtenances, and as required by Article 250 of NEC, shall be grounded:

1. Electrical service, equipment, and enclosures
2. Conduits and raceways
3. Neutral and ground conductors
4. Switches and panels
5. Motor frames, control cabinets, and lighting fixtures

B. All metallic conduits, supports, cabinets, and all the other electrical equipment shall be permanently and effectively grounded. All grounded shall be in accordance with the applicable code, and shall meet the approval of the local Inspection Department.

C. All metallic raceways shall be mechanically and electrically continuous. Where non-conductive raceways are installed, provided separated equipment grounding conductors bonded to pull and/or junction boxes at each end of each conduit run.

D. Furnish and install a separate equipment grounding wire with each branch circuit conduit, routed with the phase and neutral wires, NEVER in a separate conduit.

E. Equipment grounding wire to be routed in conduit along the phase and neutral wires (NEVER in separate conduit) per code and the Illinois Department of Public Health (IDPH) requirements.

F. Installation of the equipotential grounding system shall be as detailed in Article #18-27-517 (Chicago Electrical Code), in NFPA-70 Articles #517 and 660, and NFPA #99. The required equipment and associated panels are indicated on the electrical design drawings.

G. Exothermic Welds

1. Provided exothermic welds for the following:

   a. Ground rod to cable
   b. Cable to cable (below grade)
   c. Cable to structural steel

2. Comply with AWS Code for procedures, appearance, and quality of welds, and for methods used in correcting welding work. The manufacturer's specific instructions and molds shall be used for every weld.

H. Connectors: Provide mechanical connections for the following:

1. Cable-to-pipe
2. Cable-to-ground bus or as otherwise noted on the drawings

I. Bonding Jumpers: Bonding jumpers shall be installed where continuity of piping or metal must be maintained or as required by NEC.

3.4 INSTALLATION

A. Install grounding systems as indicated, in accordance with equipment manufacturer's written instructions and with recognized practices. Comply with applicable requirements of UL 467, UL 486A, NFPA 78 ANSI/IEEE 80, and applicable NEMA standards, to ensure that products fulfill requirements.

B. Connectors

1. Provide mechanicals connections as specified.
2. Remove non-conductive coatings such as paint, lacquer, and enamel on surfaces of equipment to be grounded.
3. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 468A to assure permanent and effective grounding.
4. Apply corrosion-resistant finish to field connections, buried metallic grounding and bonding products, and places where factory-applied protective coatings have been destroyed, which are subjected to corrosive action.
5. No connections below grade shall be covered before inspection by the Architect/Engineer.

C. Bonding Jumpers: Install on water meters and where expansion joints or dielectric unions are used.

D. Ground Bushings: Where a conduit enters a metal enclosure without a ground bus, a ground bushing shall be provided to terminate ground conductor.

E. Manholes: Metal parts and materials in manholes shall be grounded by a No. 4/0 bare copper conductor and connected to the manhole ground rod-and-cable-system ground.

F. Switchgear: Switchgear shall be grounded with a minimum No. 4/0 bare copper conduct to the building ground system or as shown on the drawings.

3.5 POOL BONDING SYSTEM

A. In addition to the associated pool electrical equipment that require grounding per Article #680.6 (grounding) of the NEC, the metal parts of the water-circulation system, pool structure and all fixed metal parts within 5′ 0″ of the inside walls of the pool shall be bonded together with a solid copper conductor not smaller than #8 awg with brass or other corrosion-resistant metal connection material.

B. Bonding system shall be in accordance with Article #680.26, paragraphs 1 thru 5, inclusive.

END OF SECTION

SECTION 16120
CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Scope: The work specified in this section includes, but shall not be limited to, providing labor, materials, equipment, and services necessary for the electrical work as shown on the drawings and as herein specified.

B. Section includes: building wires, cables, and associated connectors, splices, and terminations for wiring systems rated 600 V and less

1.2 DEFINITION

A. THHN: Heat-resistant thermoplastic insulation

B. THWN: Moisture and heat-resistant thermoplastic insulation

C. XHHW: Moisture-resistant thermoset

1.3 CODES AND STANDARDS

A. NEMA WC3: Rubber-insulated wire and cable for the transmission and distribution of electrical energy

B. NEMA WC5: Thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products and materials properly packaged in factory fabricated containers and mounted on shipping skids.

B. Store products and materials in clean, dry, heated space. Protect from dirt, fumes, water, construction debris, and traffic. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle products and materials carefully to prevent internal damage, breakage, denting, and scoring enclosure finish. Do not install damaged products or materials. Replace and return damaged products or materials to manufacturer.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

C. The contractor agrees not to void or impair or to allow any sub-contractor to void or impair any warranties regarding products or items installed as part of this project.

D. The repair of faulty workmanship shall be considered to be included in the contract.

1.9 MAINTENANCE

Not Applicable

1.10 PROJECT CONDITIONS

A. Field Measurements: Verify that field measurements are as indicated on the shop drawings and as shown on the drawings

B. Project Location Environment: Furnish and install materials suitable for the altitude, weather, and seismic requirements of the project location.

PART 2 - PRODUCTS

2.1 QUALITY

A. Electrical equipment, devices and associated materials used on this project shall be UL listed and/or labeled.

B. Equipment and devices installed under this division and not constructed with enclosure suited for mounting and protecting all live parts shall be installed in approved metal cabinets.

2.2 WIRE AND CABLE (600 V OR LESS)

A. Acceptable Manufacturers

1. General Cable Corporation (BICC)
2. Southwire
3. Okonite
4. Rome

B. Wire and cable used in this installation shall be copper and shall have 600 V insulation unless otherwise noted.

C. The wires used in this installation shall be run in conduits or approved raceways, unless specifically indicated otherwise.

D. Conductors shall conform to the latest requirements of the Code and meet ICEA Specifications. Submit the name of manufacturer for the Engineer/Architect and Owner's approval, before work is started.

E. Wire and cable shall be delivered to the project in complete coils with the manufacturer's name and approval tag attached thereto, indicating wire size and type of insulation, and be labeled and listed.

F. Unless otherwise noted, conductors for lighting and power circuits shall be #12 AWG minimum size.

G. Wire for control circuits may be #14 AWG.

H. Wire of #8 AWG size and larger shall be stranded. Wire of #10 and smaller shall be solid.

I. All conductors shall be rated 90°C for dry/wet locations.

J. AC branch circuit wiring shall be installed with color-coded conductors throughout the installation as specified in the identification sections of this specification.

2.3 WIRE CONNECTIONS

A. Acceptable Manufacturers

1. Thomas and Betts
2. Hy-Press Corporation
3. FCI Burndy Products

B. All wire connections shall be made by means of solderless connectors.

C. Clean conductor surfaces before installing lugs and connectors. Apply "no-ox" compound.

D. Branch circuit joints or splices for wires #10 and smaller shall be made with 3M brand Scotchlok electrical spring connectors. No splices shall be made in a conductor except at outlet boxes, junction boxes, or in splice boxes.

E. Control wires shall be made by 3M Scotchlok crimp connectors.

F. Use high press long barrel, cast copper, compression connectors for splices and joints for wires #8 and higher.

G. Wires and cables that terminate onto a bus bar shall be made by cast copper, two hole, long barrel lug, two crimps of fifteen ton compression, hex lugs. Lug bolts shall have lock washers.

H. The phases of all feeders shall be marked at all taps, joints, splices, and near the lugs at each end with permanently colored tapes. Tapes shall be Minnesota Mining #35 vinyl tape or as approved. Tape un-insulated conductors to 150% of insulation rating of conductor.

2.4 FISH WIRE

A. Conduits which are left empty shall contain fish wire of such a gauge required to pull in wire or cable to fill the conduit as determined by Code.

B. Each length of conduit which is to be used for the telephone system shall contain a #l4 gauge nylon fish wire.

C. Terminations of empty conduits shall be properly tagged.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THHN-THWN, single conductors in raceway or XHHW, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN, single conductors in raceway.

C. Feeders Concealed in Concrete, Below Slabs-on-Grade, and in Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN, single conductors in raceway.

F. Branch Circuits Concealed in Concrete and Below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

G. Underground Feeders and Branch Circuits: Type XHHW, single conductors in raceway.

H. Fire Alarm Circuits: Type THHN-THWN, in raceway or power-limited, fire-protective, signaling circuit cable per manufacturer's direction.

I. Class 1 Control Circuits: Type THHN, in raceway.

J. Class 2 Control Circuits: Type THHN, in raceway or power-limited cable, concealed in building finishes, or power-limited tray cable, in cable tray per manufacturer's direction.

3.2 INSTALLATION

A. All wires and cables shall be installed in conduits unless noted otherwise.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Identify and color-code conductors and cables according to Division 26 Section 26 0505, "Basic Electrical Materials and Methods," Electrical Identification.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.4 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing.

1. After installing conductors and cables and before electrical circuitry has been energized, test for proper installation and polarization.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

END OF SECTION

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SECTION 16130
RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes raceways, fittings, pull boxes, outlet boxes, floor fittings, surface and tele/power pole raceways, enclosures, and cabinets for electrical wiring.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing

B. RMC: Rigid metal conduit (heavy wall steel)

C. FMC: Flexible metal conduit

D. IMC: Intermediate metal conduit

E. LFMC: Liquidtight flexible metal conduit

F. RNC-40: Rigid non-metallic conduit, schedule 40 PVC

G. RNC-80: Rigid non-metallic conduit schedule 80 PVC

H. Fittings: Conduit connection or coupling

I. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only

J. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.

K. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and floors.

L. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.

M. Above Grade: Not directly in contact with the earth. For example, an <u>interior</u> wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.

N. Slab: Horizontal pour of concrete used for the purposes of a floor or sub-floor

1.3 CODES AND STANDARDS

A. American National Standards Institute (ANSI)

1. ANSI C80.1 – Rigid Steel Conduit, Zinc-Coated
2. ANSI C80.3 – Electrical Metallic Tubing, Zinc-Coated and Fittings
3. ANSI C80.4 – Fittings for Rigid Metal Conduit
4. ANSI C80.6 – Intermediate Metal Conduit, Zinc-Coated
5. ANSI/NEMA OS-1 – Sheet Steel Outlet Boxes, Device Box Covers and Bottom Supports
6. ANSI/NEMA OS-2 – Non-Metallic Outlet Boxes, Device Boxes, and Box Support

B. Federal Specifications (FS)

1. WC-586 – Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical Cast Metal
2. WC-408 – Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall [EMT] Type)
3. WC-1904A – PVC Rigid Non-Metallic Conduit
4. WC-563A – Electrical Metallic Tubing
5. WC-566 – Specification for Flexible Metal Conduit
6. WC-581E – Specification for Galvanized Rigid Conduit

C. NECA "Standard of Installation"

D. National Electrical Manufacturers Association (NEMA)

1. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
2. RN 2 – Packaging of master bundles for Steel Rigid Conduit, Intermediate Metal Conduit, and Electrical Metallic Tubing
3. TC 2 – Rigid Non-Metallic Conduit, PVC Schedule 40 (EPC-40) and Schedule 80 (EPC-80) PVC
4. TC 3 – Rigid Non Metallic Conduit and electrical Non-Metallic Tubing Fittings
5. TC 6 – PVC and ABS Plastics Utilities Duct for Underground Installation
6. TC-8 – Extra-Strength PVC Plastic Utilities Duct for Underground Installation
7. TC-9 – PVC and ABS Plastic Utilities Duct and Fittings for Underground Installation
8. TC 10 – PVC and ABS Plastic Communications Duct and Fittings for Underground Installation
9. TC 13 – Electrical Non-Metallic Tubing
10. TC 14 – Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
11. TC 18 – Packaging of Master Bundles for EPC 40 (Polyvinyl Chloride) Conduit
12. NEMA 250 – Enclosures for Electrical Equipment (1,000 volts maximum)

E. National Fire Protection Association (NFPA)

1. ANSI/NFPA 70 – National Electrical Code

F. Underwriters Laboratories (UL): Applicable Listings

1. UL 1 – Flexible Metal Conduit
2. UL 6 – Rigid Metal Conduit
3. UL 360 – Liquid Tight Flexible Steel Conduit
4. UL 514-B – Fittings for Conduit and Outlet Boxes
5. UL 651-A – Type EB and a PVC Conduit and HDPE Conduit
6. UL 797 – Electrical Metal Tubing
7. UL 1242 – Intermediate Metal Conduit

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Contractor's Quality Assurance Responsibilities: The Contractor shall be solely responsible for quality control of the work.

D. Manufacturer's Qualifications: Firms shall be engaged in the manufacture of products and materials of types and sizes required, and whose products have been in satisfactory use in similar service for not less than five years.

E. Contractor's Qualifications: Firms shall have at least five years of successful installation experience with projects utilizing products and materials similar to that required for this Project.

F. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and Municipal authorities having jurisdiction. Obtain approvals from such authorities.

G. Installation: Comply with NECA National Electrical Installation standards for electrical construction methods.

1.5 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, enclosures, cabinets, floor boxes, pull boxes, and outlet boxes.

C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension assembly members
2. Method of attaching hangers to building structure
3. Size and location of initial access modules for acoustical tile
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings

D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures, cabinets, accessories, and components will withstand seismic forces as listed for the zone of work that construction occurs. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

   b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products and materials properly packaged in factory fabricated containers and mounted on shipping skids.

B. Store products and materials in clean, dry, heated space. Protect from dirt, fumes, water, construction debris, and traffic. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle products and materials carefully to prevent internal damage, breakage, denting, and scoring enclosure finish. Do not install damaged products or materials. Replace and return damaged products or materials to manufacturer.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of two years after the date of substantial completion.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

C. The contractor aggress not to void or impair or to allow any sub-contractor to void or impair any warranties regarding products or items installed as part of this project.

D. The repair of faulty workmanship shall be considered to be included in the contract.

1.9 MAINTENANCE

Not Applicable

1.10 PROJECT CONDITIONS

A. Field Measurements: Verify that field measurements are as indicated on the shop drawings and as shown on the drawings.

B. Project Location Environment: Furnish and install materials suitable for the altitude, weather, and seismic requirements of the project location.

1.11 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: (Heavy Wall), hot-dipped galvanized with threaded fittings

B. IMC: zinc-coated steel, with threaded fittings

C. Plastic-Coated Steel Conduit: NEMA RN 1, with threaded fittings

D. Plastic-Coated IMC: NEMA RN 1, with threaded fittings

E. EMT: zinc-coated steel, with insulated throat compression fittings (no set screw)

F. FMC: Zinc-coated steel, with insulated throat squeeze-type connectors

G. LFMC: Zinc-coated steel with sunlight-resistant and mineral oil-resistant PVC jacket

H. Fittings: compatible with conduit and tubing materials

2.2 NONMETALLIC CONDUIT AND TUBING

A. RNC: Schedule 40 and Schedule 80 PVC

B. RNC Fittings: match to conduit or tubing type and material

2.3 METAL WIREWAYS

A. Manufacturers:

1. Hoffman
2. Square D
3. Approved Equal

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA rating as indicated on the electrical drawings

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70

E. Wireway Covers: Hinged type, screw-cover type, or flanged-and-gasketed type as indicated on the electrical drawings

F. Finish: Manufacturer's standard enamel finish

2.4 SURFACE RACEWAYS AND TELE/POWER ROLE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating standard enamel finish unless noted on the electrical drawings.

1. Available manufacturers:

a. Thomas & Betts Corporation
b. Walker Systems, Inc.; Wiremold Company (The)
c. Wiremold Company (The); Electrical Sales Division

B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Available manufacturers:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Appleton Electric Company
3. Erickson Electrical Equipment Co.
4. Hoffman
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal
7. RACO; Division of Hubbell, Inc.
8. Spring City Electrical Manufacturing Co.
9. Thomas & Betts Corporation

10. Walker Systems, Inc.; Wiremold Company (The)
11. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary

B. Construction:

1. Sheet Metal Outlet and Device Boxes: Galvanized Steel
2. Cast-Metal Outlet and Device Boxes: Type FD, with gasketed cover
3. Floor Boxes: Cast metal, fully adjustable, rectangular
4. Small Sheet Metal Pull and Junction Boxes: Screwcover or hinged as shown on the electrical drawing
5. Cast-Metal Pull and Junction Boxes: Cast aluminum with gasketed cover
6. Cabinets: Galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.6 PULL BOXES

A. Provide pull boxes as shown on the plans and where necessary to meet code and specification requirements for proper installation of associated wiring systems.

B. Pull boxes shall be sized in accordance with the National Electric Code, NFPA 70.

C. Boxes indicated on the plans are not intended to be drawn to scale.

D. Conduit runs of more than 100 feet or with more than the equivalent of three 90 degree bends shall have suitable pull boxes installed in convenient intermediate locations. Such pull boxes shall be shown on the shop drawings and construction record drawings.

E. Pull boxes over 100 cubic inches shall be supported independently of the conduits.

F. Pull boxes shall be accessible after completion of installation.

2.7 OUTLET BOXES

A. Boxes for Suspended or Bracket Mounted Lighting Fixtures: Ceiling outlets and bracket outlets which are to support lighting fixtures shall be equipped with a ⅜" malleable iron fixture stud securely fastened into the outlet box.

B. Flush Mounted Boxes (in plaster, drywall, poured concrete, smooth tile):

1. Outlet boxes for duplex receptacles, single and two-gang toggle switches, shall be a minimum of 4" square by 1½" deep.
2. Outlet boxes for other devices installed under similar conditions shall be a minimum of 4" square 1½" deep.
3. Where more than two conduits enter an outlet box, a 2 ⅛" deep box shall be used, except in columns.
4. Where three or more gangs of devices are required, solid gang boxes a minimum of 4 ½" high by 1⅝" deep shall be used.
5. Provide suitable plaster rings as required.
6. Provide minimum of ½" deep tile covers as required.

C. Flush Mounted Data/Telephone or Clock Outlet Boxes: Outlet boxes which are to be used as data/telephone outlets or clock outlets shall conform to the requirements of switch and receptacle outlets, employing a single gang opening in the plaster cover, unless noted otherwise on the electrical drawings.

D. Capped Outlet Boxes: Outlet boxes which are indicated as capped outlet boxes shall employ flat metal cover plates, fastened to the outlet box with screws.

E. Surface Mounted Outlet Boxes: Where outlet boxes are to be installed exposed on ceiling or wall surfaces, the boxes shall be specifically designed for such a type of installation and shall be square or rectangular as required. Device plates shall match the contour of the boxes and shall be of the type manufactured for these particular type boxes. In finished areas, all boxes shall be flush mounted unless specifically noted otherwise.

F. Suspended Ceiling Outlet Boxes:

1. Where outlet boxes are installed in suspended ceiling cavities for the purpose of splicing fixture wire, branch circuit conductors and for connecting flexible metallic conduit between this box and the lighting fixtures, such boxes shall be of the size required by code requirements pertaining to the number of conductors entering and leaving the box. Minimum box size shall be 4″ square by 1½″ deep.
2. Each box shall be secured to the ceiling channel irons or building structure and shall have its opening facing the nearest recessed lighting fixture.
3. All boxes shall have covers or device plates as required.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid steel or IMC
2. Concealed: Rigid steel or IMC
3. Underground, concrete encased beyond 5′0″ of building: RNC-40
4. Underground, non-concrete encased beyond 5′0″ of building: RNC-80
5. Connection to Vibrating Equipment (including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC
6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4

B. Indoors:

1. Exposed Dry Locations: EMT
2. Concealed in Interior Partition: EMT
3. Connection to Vibrating Equipment (including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations
4. Damp or Wet Locations: RMC or IMC
5. Concealed in Concrete or Block Walls: RMC or IMC
6. Mechanical Rooms and Penthouses: RMC or IMC
7. Imbedded in Concrete Slabs: RMC or IMC
8. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
   a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel

C. Minimum Raceway Size: ¾″ trade size (DN 21).

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.2 INSTALLATION

A. Keep raceways at least 6" (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 16 Section 16050, "Basic Electrical Materials and Methods."

D. Install temporary caps to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2" (50 mm) of concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1" trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above the floor.

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

J. Join raceways with fittings designed and approved for that purpose and make joints tight.

K. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength.

M. Telephone and Signal System Raceways, 2" Trade Size (DN 53) and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces
2. Where otherwise required by NFPA 70

O. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6" (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

P. Flexible Connections: Use maximum of 72" (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

Q. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

R. Bushings

1. Provide bushings wherever IMC, RMC, or EMT conduit is terminated, including stub-outs, and locations not provided with connection fittings or boxes.
2. Insulated Bushings
   a. Provide insulated bushings or connections for IMC, RMC, or EMT conduit terminations.
   b. Insulated bushings shall be OZ/Gedney Co., Type PBP for rigid conduit or Type "SBT" for EMT, or approved equal.
3. Grounded Type Insulated Bushings
   a. Provide grounded type insulated bushings for all electric service and distribution feeder conduits, including stub-outs.
   b. Bushings shall be properly grounded and/or bonded.
   c. Ground type insulated bushings shall be OZ/Gedney Co. Type "BLG" or approved equal.

4. Insulating Bushings
   a. Provide insulating bushings where cables pass through walls of metal enclosures. Bushings shall be OZ/Gedney Co. Type "BBL" or "ABB" or approved equal.
   b. Insulated bushings shall be used at ends of threaded rigid conduits and threaded fittings. Provide double locknuts when terminated in enclosure.
   c. Bushings shall be OZ/Gedney Co. Type "A" or approved equal.

S. Rigid Conduit Fittings and Couplings
1. Running threads shall not be used on conduit for connection at couplings.
2. IMC and RMC conduits shall be joined by approved threaded couplings.
   a. Threadless couplings and connectors are not acceptable.
   b. Set screw couplings are not acceptable.
   c. Split couplings are not acceptable.
3. Joints in conduit which are installed under or in the floor slab, or in exterior walls shall be made watertight by using T&B Kopr-shield thread compound on each joint.

T. Electric Metallic Tubing (EMT) Conduit Fittings and Couplings
1. Only insulated throat type compression fittings shall be used.
2. Only compression-type fittings shall be used, set screw fittings and couplings are not acceptable.

U. Couplings and unions shall be mechanically strong and shall be so installed to make a continuous bond between the conduits connected.

3.3 PULLING COMPOUND

A. If it is desired to use a pulling compound on wire and cable, first obtain the approval of the Engineer/Architect before employing such compounds. Compound shall be UL listed and compatible with conductor insulation covering.

B. Conduits shall be swabbed until moisture and dirt are removed and before wires are pulled or cables are installed.

3.4 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.5 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 16140
WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Scope: The work specified in this section includes, but shall not be limited to, providing labor, materials, equipment, and services necessary for the electrical work shown on the drawings and as herein specified.

B. Section includes: receptacles, dimmer switches, toggle switches, and finish plates.

1.2 DEFINITIONS

A. GFI: Ground-fault circuit interrupter.

1.3 CODES AND STANDARDS

A. FS W-C-596 – Electrical Power Connector, Plug, Receptacle, and Cable Outlet

B. FS W-S-896 – Switch, Toggle

C. NEMA WD 1 – General Color Requirements for Wiring Devices

D. NEMA WD 6 – Wiring Devices – Dimensional Requirements

E. UL 1472 – Solid State Dimming Controls

F. UL 943 – Standard for Ground Fault Circuit Interrupters

G. UL 498 – Standard for Attachment Plugs and Receptacles

H. UL 20 – Standard for General Use Snap Switches

I. DSCC W-C-896F – General Specification for Electrical Power Connector

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NFPA 70.

1.5 SUBMITTALS

A. Product Data: For each product specified

B. Shop Drawings: Legends for receptacles and switch plates

C. Samples: For devices and device plates for color selection and evaluation of technical features

D. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 01

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products and materials properly packaged in factory fabricated containers and mounted on shipping skids.

B. Store products and materials in clean, dry, heated space. Protect from dirt, fumes, water, construction debris, and traffic. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle products and materials carefully to prevent internal damage, breakage, denting, and scoring enclosure finish. Do not install damaged products or materials. Replace and return damaged products or materials to manufacturer.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of two years after the date of substantial completion. Certain equipment shall be warranted at the time of final acceptance, or for longer periods of time as specified in those sections of the project manual.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

C. Any manufacturer's warranties concerning any item installed shall be to the benefit of Owner.

D. The contractor agrees not to void or impair or to allow any sub-contractor to void or impair any warranties regarding products or items installed as part of this project.

E. The repair of faulty workmanship shall be considered to be included in the contract.

1.9 MAINTENANCE

Not Applicable

1.10 PROJECT CONDITIONS

A. Field Measurements: Verify that field measurements are as indicated on the shop drawings and as shown on the drawings.

B. Project Location Environment. Furnish and install materials suitable for the altitude, weather, and seismic requirements of the project location.

1.11 COORDINATION

A. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

B. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

C. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 SWITCHES AND RECEPTACLES

A. Provide the various switches and receptacles shown on the plans.

B. In general, the color of all devices shall be brown or ivory. UPS protected receptacles shall have an orange nylon face, emergency system receptacles shall have a red nylon face, and surge suppression shall have a blue nylon face.

C. All devices shall be Underwriters' Laboratories listed, Federal specification listed, heavy-duty type. Receptacles shall be grounding type.

D. Devices shall be manufactured by the following:

1. Duplex receptacles, 20 Ampere, 125 Volt

a. Standard duplex [Brown or Ivory]

(1) P&S/Legrand #5362
(2) Hubbell #HBL5352
(3) Leviton #5362
(4) Cooper #5362

b. Isolated Ground [Orange]

(1) P&S/Legrand #IG6300
(2) Hubbell 5352IG
(3) Leviton 8300IG
(4) Cooper #IG8300RN

c. Ground Fault Circuit Interrupter (GFI) [Brown or Ivory = Normal; Red = Emergency]

(1) P&S/Legrand #1591 (Hospital Grade # 2091-HG)
(2) Hubbell #GF5362 (Hospital Grade # HFG 8300)
(3) Leviton #6899-HG (Hospital Grade #6898-HG)
(4) Cooper #GF20 (Hospital Grade #HGF20)

d. Surge Protection [Blue]

(1) P&S/Legrand #5362BLSP
(2) Hubbell #HBL-5362SAS
(3) Leviton #5380-B
(4) Cooper #1210BL

e. Hospital Grade Receptacle (Normal) [Brown or Ivory]

(1) P&S Legrand #8300
(2) Hubbell #HBL8300
(3) Leviton #8300
(4) Cooper #8300

f. Hospital Grade Receptacle (Emergency) [Red]

(1) P&S/Legrand #8300RED
(2) Hubbell & HBL8300R
(3) Leviton #8300R
(4) Cooper #8300RD

2. Toggle switches 20A, 120-277V [Brown or Ivory = Normal; Red = Emergency]

a. Single Pole

(1) Hubbell 1221
(2) P&S/Legrand #20AC1
(3) Leviton #1221
(4) Cooper #2221

b. Double Pole

(1) Hubbell 1222
(2) P&S/Legrand #20AC2
(3) Leviton #1222
(4) Cooper #2222

c. Three Way:

(1) Hubbell 1223
(2) P&S/Legrand #20AC3
(3) Leviton #1223
(4) Cooper #2223

d. Four Way: HBL1224

(1) Hubbell 1224
(2) P&S/Legrand #20AC4
(3) Leviton #1224
(4) Cooper #2224V

2.2 COMMUNICATIONS OUTLETS

A. Data/Telephone Outlet:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 3560-6.
b. Leviton; 40649.

2. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 6. Comply with UL 1863.

B. Combination TV and Data/Telephone Outlet:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 3562.
b. Leviton; 40595.

2. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 6; and one Type F coaxial cable connector.

2.3 DEVICE PLATES

A. Device plates shall be of same manufacture as device, and shall be flat surface type.

B. Device plates in mechanical and electrical equipment rooms and unfinished areas shall be cadmium-plated steel.

C. Device plates in finished areas shall be stainless steel Type 302. [Nylon, brown or ivory, to match device; or red emergency system.]

D. All multi-gang plates shall be one piece.

E. Plates for outlet boxes shall contain a label for identifying circuit number and panel source. See specification Division 26 Section 26 0505, “Electrical Identification,” for additional information.

2.4 POWER OUTLETS

A. Power outlets for equipment requiring outlets other than standard duplex receptacle configurations shall match the "NEMA" rating of the equipment to be served or as specified on the electrical drawings.

B. Manufacturers of power outlets shall match those specified under duplex receptacles.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies plumb and secure.

B. Install wall plates when painting is complete.

C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

F. Protect devices and assemblies during painting.

G. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Electrical Identification."

B. Comply with Division 16 Section, "Basic Electrical Materials and Methods."

1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

A. Connect wiring device grounding terminal to outlet box with bonding jumper.

B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.

B. Check TVSS receptacle indicating lights for normal indication.

C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

D. Replace damaged or defective components.

3.5 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

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SECTION 16410
SAFETY AND DISCONNECT SWITCHES/ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes the following:

1. Equipment disconnects
2. Motor-circuit disconnects
3. Molded case circuit breaker in an individual enclosure
4. Elevator fusible shunt trip control panel

1.2 DEFINITIONS

Not Applicable

1.3 CODES AND STANDARDS

A. NEMA KS-1 – Enclosed Switches

B. NFPA 70 (NEC)

1.4 QUALITY ASSURANCE

A. Comply with codes for components and installation.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

C. Single-Source Responsibility: All enclosed switches and circuit breakers shall be the product of a single manufacturer.

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product data for switches and accessories specified in this Section.

C. Descriptive data and time-current curves for protective devices and let-through current curves for those devices with current-limiting characteristics. Include coordination charts and tables, and related data.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Where recommended by the equipment supplier, deliver equipment in fully enclosed vans after specified environmental conditions have been permanently established in spaces where equipment is to be placed. The products accepted on the site shall be wrapped in factory packing and shall be inspected for damage prior to acceptance.

C. Store equipment in clean, dry with non-condensing environments that are controlled within manufacturer's ambient tolerances for non-operating equipment. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

D. Handle equipment carefully to prevent damage, breaking, and scoring. The contractor shall not install damaged units or components; replace with new.

E. Equipment furnished by others. The contractor shall be responsible for receiving, uncrating, inspecting, storing, and installing of Division 26 equipment listed as furnished by others.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. Motor and circuit disconnects and breakers shall be warranted for a minimum period of two years after project completion, or longer if manufacturer's warranty allows.

1.9 MAINTENANCE

Not Applicable

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide enclosed switches and circuit breakers by one of the following:

1. Safety Switches:
   a. General Electric
   b. Square D
   c. Cutler-Hammer
2. Circuit Breakers:
   a. General Electric
   b. Square D
   c. Cutler-Hammer
3. Elevator fusible shunt trip control panel:
   a. Bussmann division of Cooper Industries
   b. Ferraz Shawmut

2.2 GENERAL

A. Disconnect and Safety Disconnect Switches:

1. General: Provide heavy duty surface-mounted safety switches for motors and equipment unless otherwise indicated, of types, sizes, and electrical characteristics as indicated on the electrical drawings and equipment schedules.
2. Switch Interiors: Switches shall have switch blades which shall be fully visible in the off position when the enclosure door is open. Current carrying parts shall be plated copper and switch contacts shall be silver-tungsten. Lugs shall be removable and shall be UL-listed for 75 degrees C, copper wire.

3. Switch Operator: Switches shall be quick-made, quick-break type. The operating handle shall be an integral part of the enclosure base and shall be padlockable in the off position. The handle position shall indicate whether the switch is in the on or off position.
4. Interlock Contacts: Provide two Form C auxiliary, 10 ampere, 300V rated contacts. The contacts shall provide for two normally open and two normally closed contacts for switch open or closed position.

B. Circuit Breakers:

1. All circuit breakers shall comply with NEMA ABI and FSW-C-375.
2. Circuit breakers shall be securely bolted to the enclosure and be flush with the box assembly.
3. Circuit breakers shall have over center toggle mechanism with quick-make, quick break action, common trip for all pole positions, and a handle position indicator with breaker rating imprinted in a location easily verified without removing the box cover.
4. Circuit breakers for heating, air conditioning, refrigeration and all motor loads shall be HCAR rated.
5. Circuit breaker size(s) shall be listed on the electrical plan drawings or equipment schedule.

2.3 ENCLOSURES

A. NEMA 1: Provide NEMA 1 general purpose enclosures for indoor installation unless otherwise indicated on the drawings. Enclosure covers shall be attached with pin type hinges. Enclosures shall have a gray baked enamel finish, electrodeposited on clean, phosphatized steel.

B. NEMA 3R: Provide NEMA 3R general purpose enclosures for outdoor installation unless otherwise indicated on the drawings. Enclosure cover shall be attached with pin type hinges and shall be securable in the open position. NEMA 3R enclosures shall be manufactured from galvanized steel. Enclosures shall have a gray baked enamel finish, electrodeposited on cleaned, phosphatized steel. Provide rainproof bolt-on hubs.

2.4 RATINGS

A. General: Provide heavy duty safety switches and circuit breakers with ampere rating as shown on the drawings.

B. Horsepower-Rated: Safety switches shall be horsepower-rated for 250, 480, and 600V, AC and DC, and shall be rated for the motor driven loads supplied by the switch.

C. Short Circuit Rating: Safety switches with Class RK1 or Class L fuses shall have a UL short circuit rating of 100,000 amperes RMS symmetrical minimum.

D. Circuit breakers shall have a UL short circuit rating of 65,000 amperes RMS symmetrical minimum.

2.5 FUSIBLE SWITCHES

A. Provide fusible disconnect switches as shown on the drawings.

B. Fusible disconnects rated 30 through 600 amperes shall have Class RK1 fuse clips. Refer to Division 16, Section 16491 for acceptable fuse manufacturers.

C. Disconnects rated 800 through 1200 amperes shall have Class L fuse clips. Refer to Division 16, Section 16491 for acceptable fuse manufacturers.

2.6 IDENTIFICATION

A. Each disconnect switch, circuit breaker, and shunt trip control panel shall have an engraved, laminated bakelite nameplate attached to the outside of the enclosure. The nameplate shall include the switch or breaker designation and the equipment it serves. Attach the nameplate by screws or rivets. See Division 16, Section 16050.

2.7 ELECTRICAL INTERLOCKS

A. Provide electrical interlock switches on disconnects as specified herein. The interlock switches shall open prior the opening of the power switch and close only after the power switch has been enclosed. Provide two sets normally open (NO) and normally closed (NC) switches for each disconnect.

B. Provide the necessary control wiring to the interlock switch to disconnect the control circuit from the motor controller.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed switches, breakers, and control panels in locations as indicated, according to manufacturer's written instructions. Comply with all applicable requirements of electrical installations and for the seismic zone of this project.

B. Install enclosures level and plumb.

C. Install wiring between enclosed switches and control/indication devices as required.

D. Connect switches, breakers, panels, enclosures, and components to wiring system and to equipment ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

E. Mounting: Mount enclosures on building structures adjacent to equipment unless otherwise noted. Enclosures shall not be mounted on equipment served, unless it is a part of a preassembled control panel. If building structure is not adjacent to the equipment, provide a separate unistrut rack with supports, clear of equipment, for mounting of switch and breaker enclosure. Conduits shall not be used for the support means.

F. Location:

1. Disconnects and breaker enclosures shall be readily accessible and shall not interfere with removal of equipment parts or with standard maintenance. Disconnects and breaker enclosures shall be installed with their top at 5½ feet above the floor unless otherwise noted on the drawings.
2. Elevator shunt trip control panel shall be mounted at the location(s) specified by the elevator manufacturer's requirements. If no requirements are available, mount panel as close as possible to the latch side of the door, inside the elevator machine room.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will employ and pay an independent testing agency to perform specified field quality-control testing.

3.3 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

3.4 FLASH PROTECTION WARNING SIGNS

A. The electrical contractor shall provide all flash protection warning signs as required by the NEC Article 100.16. Warning signs shall conform to the requirements of NFPA 70E.

1. All electrical equipment such as switchboards, panelboards, control panels, meter socket enclosures, and motor control centers, that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electrical hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.\
2. All warning signs MUST be installed before owner's personnel are trained on the use of the equipment.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules for start-up and shutdown, troubleshooting, servicing, and preventive maintenance.

B. Review data in Division 01, "Operating and Maintenance Manual." Refer to Division 01, "Project Closeout."

C. Schedule training with Owner through the Architect with at least 7 days' advance notice.

END OF SECTION

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SECTION 16491
FUSES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes the following:

1. Cartridge fuses, rated 600V and less, for use in switches, panelboards, switchboards, controllers, and motor control centers; and spare fuse cabinets.
2. Cable limiters for use on service entrance applications where multiple cables per phase are installed.

1.2 DEFINITIONS

A. Fuse: A safety device that protects an electric circuit from excessive current, consisting of or containing a metal element that melts when current exceeds a specific amperage, thereby opening the circuit.

1.3 CODES AND STANDARDS

A. UL 198C: High-Interrupting Capacity Fuses; Current Limiting Types.

B. UL 198E: Class R Fuses.

C. FS W-F-870: Fuseholders (For Plug and Enclosed Cartridge Fuses).

D. NEMA FU 1: Low Voltage Cartridge Fuses.

E. NFPA 70: National Electrical Code.

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide fuses and cable limiters from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with NEMA FU 1.
2. Comply with NFPA 70.

1.5 SUBMITTALS

A. Product Data: Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings for each fuse type indicated.

1.6 DELIVERY AND STORAGE

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Where recommended by the equipment supplier, deliver equipment in fully enclosed vans after specified environmental conditions have been permanently established in spaces where equipment is to be placed. The products accepted on the site shall be wrapped in factory packing and shall be inspected for damage prior to acceptance.

C. Store equipment in clean, dry with non-condensing environments that are controlled within manufacturer's ambient tolerances for non-operating equipment. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

D. Handle equipment carefully to prevent damage, breaking, and scoring. The contractor shall not install damaged units or components: replace with new.

1.7 SPARE PARTS

A. Furnish extra materials described below that match products installed and that are packaged in original cartons or containers and identified with labels describing contents.

1. Fuses: Quantity equal to 10% of each fuse type and size, but not fewer than three of each type and size.
2. Provide two (2) fuse pullers to Owner.

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion. Certain equipment shall be warranted at the time of final acceptance, or for longer periods of time as specified in those sections of the project manual.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

1.9 MAINTENANCE

A. Replace failed fuses during period of construction. Replacement of blown fuses after substantial completion will be the responsibility of this contractor, thru the warranty period, using the Owner's spare fuses.

1.10 COORDINATION

A. Coordinate fuse ratings with HVAC, refrigeration equipment, and motor nameplate ratings for maximum fuse size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fuses, 30 through 600 amperes:
   a. Bussman #LPS-RK-SP
   b. Ferraz Shawmut #AMP TRAP 2000 RK1
   c. Little Fuse Power Gard #LLSRK-1D Series
2. Cable limiters, size 4/0 through 750 mcm cable:
   a. Bussman #KC Series
   b. Ferraz Shawmut #CP Series

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install cable limiter devices on both ends (at load side of service transformer and at line side of main switch) of incoming electrical service cables where multiple-cables-per-phase systems are installed.

3.3 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION

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SECTION 16515
INTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes interior lighting fixtures, lamps, ballasts, emergency lighting units, and accessories.

1.2 DEFINITIONS

A. Lighting Fixture: A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

B. Fixture: A complete lighting unit, exit sign, or emergency lighting unit. Fixtures include lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply. Internal battery-powered exit signs and emergency lighting units also include a battery and the means for controlling and recharging the battery. Emergency lighting units include ones with and without integral lamp heads.

1.3 CODES AND STANDARDS

A. ANSI C82.1: American National Standard for Fluorescent Lamp Ballast – Line Frequency Fluorescent Lamp Ballast.

B. ANSI C82.11: High Frequency Fluorescent Lamp Ballasts.

C. ANSI C82.4: High-Intensity Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

D. ANSI C82.6: Ballasts for HID Lamps – Method Measurement

E. NEMA LE 2: H-I-D Lighting System Noise Criterion (LS-NC).

F. NFPA 70: National Electricity Code (NEC)

G. UL 935: Standard for Fluorescent Lamp Ballasts.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Provide components that comply with National Electrical Code - NFPA-70 and that are listed and labeled by Underwriters Laboratory where available.

B. Listing and Labeling: Provide fixtures, emergency lighting units, and accessory components specified in this Section that are listed and labeled for their indicated use and installation conditions on Project.

C. Special Listing and Labeling: Provide fixtures for use in damp or wet locations, underwater, and recessed incombustible construction that are specifically listed and labeled for such use. Provide fixtures for use in hazardous (classified) locations that are listed and labeled for the specific hazard.

1. The Terms “Listed” and “Labeled”: As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

1.5 SUBMITTALS

A. Product Data: For each type of lighting fixture indicated, submit each item in this Article according to the conditions of the contract and Division 01 specification section. Arrange in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures.
2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
4. Emergency lighting unit battery and charger.
5. Fluorescent and high-intensity-discharge ballasts.
6. Sound Performance Data: For air-handling fixtures. Indicate sound power level and sound transmission class in test reports certified according to ADC.
7. Types of lamps.

B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.

1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.

C. Coordination Drawings: Reflected ceiling plans and sections drawn to scale and coordinating fixture installation with ceiling grid, ceiling-mounted items, and other components in the vicinity. Include work of all trades that is to be installed near lighting equipment.

D. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.

E. Dimming Ballast Compatibility Certificates: Signed by manufacturer of ballast certifying that ballasts are compatible with dimming systems and equipment with which they are used.

F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle lighting fixtures to avoid damage to housing, components, and finishes.

1.7 SPARE PARTS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Battery and Charger For emergency lighting units: 1 for every 10 of each type and rating installed. Furnish at least one of each type.

4. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty for Batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for Batteries: Manufacturer's standard, but not less than 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for last nine years.

C. Special Warranties for Fluorescent Ballasts: Written warranty, executed by manufacturer agreeing to replace fluorescent ballasts that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for Electronic Ballasts: Five years from date of manufacture, but not less than four years from date of Substantial Completion.
2. Special Warranty Period for Electromagnetic Ballasts: Manufacturer's standard warranty, but not less than two years from date of manufacture.

1.9 MAINTENANCE

A. Lamp Seasoning

1. Operate all fluorescent and HID lamps for 100 hours prior to requesting final observation. Season fluorescent lamps at 3 hour on, 20 minute off cycle. Operate dimming fluorescent lamps at 100% output during seasoning. Season HID lamps at an 11 hour on, 1 hour off cycle.

B. Relamping

1. Replace failed lamps at completion of work. Replacement of incandescent and other lamps burnouts after the warranty period starts shall be the responsibility of the Owner.

C. Adjusting and Cleaning

1. Align luminaries and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaries.
2. Touch up lighting fixture finish at completion of work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated on the Electrical Drawings.

B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation on the Lighting Fixture Schedule.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85%.
2. Specular Surfaces: 83%.
3. Diffusing Specular Surfaces: 75%.
4. Laminated Silver Metallized Film: 90%.

E. Lenses, Diffusers, Covers, and Globes: 100% virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
2. Lens Thickness: 0.125" (3 mm) minimum, unless greater thickness is indicated.

F. Electromagnetic Interference Filters: Integral to fixture assembly. Provide one filter for each ballast. Suppress conducted electromagnetic interference filters as required by MIL-STD-461.

2.3 FLUORESCENT LAMP BALLASTS

A. General Requirements: Unless otherwise indicated, features include the following:

1. Designed for type and quantity of lamps indicated at full light output.
2. Sound Rating: A, except as otherwise indicated.
3. Type: Class P, High Power Factor, except as otherwise indicated.

B. Electronic Ballasts: Unless otherwise indicated, features include the following, besides those in "General Requirements" Paragraph above:

1. Certified Ballast Manufacturer Certification: Indicated by label. (ETL and CBM)
2. Encapsulation: Without voids in potting compound.
3. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
4. Total Harmonic Distortion & Voltage: Less than or equal to 10% THD. Instant start with dual voltage (120/277v).

C. Ballasts for Lamps in Nonrecessed Fixtures: Unless otherwise indicated, additional features include the following:

1. Power Factor: 95%, minimum.
2. Ballast Coil Temperature: 65 deg C, maximum.
3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.

4. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

D. Ballasts for Low-Temperature Environments: As follows:

1. Temperatures 0F (-17C) and Above: Electronic type rated for 0F (-17C) starting temperature.
2. Temperatures -20F (-29C) and Above: Electromagnetic type designed for use with high-output lamps.

E. Ballasts for Low Electromagnetic Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C for limitations on electromagnetic and radio-frequency interference for consumer equipment.

F. Acceptable Manufacturers: Advance; Osram/Sylvania; Lutron; Motorola or approved equal.

2.4 EXIT SIGNS

A. General Requirements: Comply with UL 924 and the following:

1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.

B. Internally Lighted Signs: As follows:

1. Lamps for AC Operation: Incandescent, two for each fixture, 50,000 hours rated lamp life.
2. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours rated lamp life.
3. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.
4. Additional Lamps for DC Operation: Two minimum, bayonet-base type, for connection to external dc source.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80% of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.5 EMERGENCY FLUORESCENT POWER SUPPLY UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit factory mounted within fixture body. Comply with UL 924.

1. Test Switch and Light-Emitting Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
2. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum 10-year nominal life.
3. Charger: Fully automatic, solid-state, constant-current type.

4. Operation: Relay automatically energizes lamp from unit when normal supply circuit voltage drops to 80% of nominal voltage or below. When normal voltage is restored, relay disconnects lamp, and battery is automatically recharged and floated on charger.

B. External Type: Self-contained, modular, battery-inverter unit. Comply with UL 924.

1. Test Switch and Light-Emitting Diode Indicator Light: Visible and accessible without entering ceiling space.
2. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum 10-year nominal life.
3. Charger: Fully automatic, solid-state, constant-current type.
4. Operation: Relay automatically energizes lamp from unit when normal supply circuit voltage drops to 80% of nominal voltage or below. When normal voltage is restored, relay disconnects lamp, and battery is automatically recharged and floated on charger.
5. Housing: NEMA 250, Class 1 enclosure.

2.6 LAMPS

A. Fluorescent Color Temperature and Minimum Color-Rendering Index: 3500 K and 85 CRI, unless otherwise indicated.

B. Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid-start circuits.

C. Acceptable Manufacturers: General Electric, Phillips or Sylvania.

2.7 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: ½" (12-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, ½" (12-mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

D. Rod Hangers: 3⁄16" (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.8 FINISHES

A. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
2. Metallic Finish: Corrosion resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture. Support fixtures according to requirements of Division 26 Basic Electrical Materials and Methods.

B. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48" (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings.

C. Lighting fixture Attachment: Fasten to indicated structural supports.

D. Lighting fixture Attachment with Adjustable Features or Aiming: Attach lighting fixtures and supports to allow aiming for indicated light distribution.

E. Lamp lighting fixtures with indicated lamps according to manufacturer's written instructions. Replace malfunctioning lamps.

3.2 CONNECTIONS

A. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed unit for damage. Replace damaged units.

B. Advance Notice: Give dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests and Observations: Verify normal operation of lighting units after installing lighting fixtures by energizing circuits with normal power source, and performing the following:

1. Measure light intensities at night if specific illumination performance is indicated. Use photometers with calibration referenced to NIST standards.
2. Check intensity and uniformity of illumination.
3. Check excessively noisy ballasts.
4. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation. Verify transfer to emergency/battery source and retransfer to normal.

E. Prepare a written report of tests, inspections, observations and verifications indicating and interpreting results.

F. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

3.4 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

END OF SECTION

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SECTION 16721

ADDRESSABLE FIRE ALARM SYSTEM

1. PART 1 – GENERAL

1.01. SCOPE

A. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations associated with the installation of the new fire alarm system components as shown on the drawings and as herein specified.

B. Within this specification, unless specifically noted otherwise, the term "detector" shall be used to refer to automatic fire detectors, which support Intelligent Addressable detection technologies, as follows:

1. "Intelligent Addressable Smoke Detector" technology – where the detectors utilized within this system function as intelligent detectors. These detectors shall contain processing and memory circuits within each detector unit. If desired, the Analog Smoke Obscuration Value at any such detector can be manually retrieved to the FACP for report or adjustment purposes. Where Intelligent Addressable Detectors are utilized, historical data and / or floating average values associated with each Sensor – such as the Average, Peak, and Current Obscuration Values, shall be maintained within the memory of detector itself. Where Intelligent Addressable Smoke Detectors are utilized, Alarm conditions shall be determined locally, at the detectors.

2. Non-addressable detectors shall be unacceptable, except at individual locations where specified – where ambient environmental values prevent use of addressable units.

3. Simple Addressable systems, which do not support Intelligent Addressable detection technology shall also be unacceptable.

C. Only detection utilized as part of the preaction system will be permitted to be of conventional design.

1.02. RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions, and the applicable provisions of Division 1, govern work under this section.

1.03. RELATED WORK

A. The following technical fire protection specifications sections are directly related to the provisions of this section.

Section 15000C – Common Work Results for Fire Suppression
Section 15300C – Water Based Fire Suppression Systems

Section 15320C – Fire Pumps

1.04. REFERENCE STANDARDS

A. Specific standards referenced in this section are as follows:

NFPA 70 - National Electrical Code (NEC) Generally, and Article 760 in particular
NFPA-72 – National Fire Alarm Code
NFPA 101 - Life Safety Code
NFPA-90A - Installation of Air Conditioning and Ventilating Systems
State of Wisconsin Codes (COMM)
National Electrical Manufacturer's Association (NEMA)
Underwriters' Laboratories, Inc. (UL)

UL-864 Control Units for Fire Protective Signaling Systems
UL-268 Smoke Detector for Fire Protective Signaling Systems
UL-217 Smoke Detectors for Single and Multiple Station
UL-521 Heat Detectors for Fire Protective Signaling Systems
UL-464 Audible Signaling Appliances
UL-1971 Visual Signaling Appliances
UL-38 Manually Actuated Signaling Boxes
UL-1481 Power Supplies for Fire Protective Signaling Systems

1.05. SHOP DRAWINGS

A. Submit shop drawings in accordance with Division 1 and Division 16.

B. Submittal drawings:

1. Provide submittal drawings that are in compliance with requirements for fire alarm system submittals. This shall include:

a. Battery calculations
b. Voltage drop calculations for all signal lines
c. Sequence of operation
d. Wiring diagrams
e. Floor plan layout of all fire alarm devices indicating candela levels on each individual signal.

2. These shall be used, per City of Milwaukee requirements for fire alarm submittals. This information shall be included with each set of fire alarm shop drawings.

3. Provide each submittal booklet with a table of contents that includes all items in submittal, specifically it shall include the following. This page shall be a separate page to allow engineer's stamp for State submittal.

a. Page listing for battery calculations.

b. Page listing for voltage drop calculations for all signal lines.
c. Page listing Sequence of Operation.
d. Page listing overall one-line wiring diagram.
e. Page listing catalog cut sheets.
f. Page listing floor plan layouts, if they are included in the booklet.
g. Page listing all other items that are included in the booklet.
h. Full set of fire alarm drawings with fire alarm devices indicated and proper candela levels indicated on those devices.

1.06. OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Division 1 and Division 16.

B. The following information shall be submitted in addition to the items listed above:

1. Wiring diagram indicating wire size and type for each individual piece of equipment.

2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.

3. Provide copy of written warranty.

1.07. QUALITY ASSURANCE

A. Provide quality assurance in accordance with Division 1 and Division 16.

B. The following shall be provided in addition to items listed above.

1. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

2. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

3. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation. Report results in writing.

4. Manufacturer must carry replacement parts.

1.08. WARRANTY

A. The supporting devices shall be warranted for a period of not less than 1 year from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, and repair parts cost.

C. Submit a written warranty executed by the installer agreeing to repair or replace any fire alarm equipment that fails within the warranty period.

D. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

E. System Service Support

1. The system's vendor must employ factory trained technicians and maintain a service organization within 100 miles of the job site. This organization must have a minimum of 10 years experience servicing fire alarm systems and provide 24 hour emergency service.

2. PART 2 – PRODUCTS

2.01. GENERAL

A. The contractor shall provide fire alarm system manufactured by: EST, FCI (Gamewell), Mircon, Notifier, Simplex, or approved equal.

B. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

C. Provide a complete and fully functional fire alarm system using materials and equipment of types, sizes, and rating as required to meet performance requirements. Use materials and equipment that comply with referenced standards and manufacturer's standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions. Provide all accessories necessary for a fully functioning system.

D. Power Requirements

1. The control panel shall receive 120 VAC power via a dedicated circuit. See drawings for circuit number.

2. All circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel.

3. Provide supervised remote battery backed-up power supplies if required. Coordinate with contractor at bid to include 120 volt connection in bid.

E. Alarm Sequence

1. The system alarm operation subsequent to the alarm activation of any manual station, automatic detection device, or sprinkler flow switch is to be as follows:

    a. All audible alarm indicating appliances shall sound until silenced by the alarm silence switch at the control panel.

    b. Xenon strobes shall display a continuous pattern until system is reset. Horn/strobes will operate a continuous Code-3 temporal pattern until the system is reset.

    c. All doors normally held open by door control devices shall release.

    d. To accommodate and facilitate job site changes, the type of "city connection circuit" is to be on site configurable to provide a "reverse polarity", "local energy", "shunt" or dry contact connection.

    e. The mechanical controls shall activate the air handling systems per life safety specification NFPA 101.

    f. Upon reset of control panel, air handling units shall sequentially start up to reduce electrical demand.

2. The alarm activation of any elevator lobby smoke detector shall, in addition to the operations listed above, cause the elevator cabs to be recalled. This programming is addressed by the existing Fire-Lite MS5210UD panel.

3. The activation of any system smoke detector shall initiate an Alarm Verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If, within one minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within one minute, the system is to resume normal operation. The Alarm Verification is to operate only on smoke detector alarms. Other activated initiating devices shall be processed immediately. The alarm verification operation is to be U.L. listed.

4. The control panel is to have a dedicated system trouble LED and a dedicated trouble acknowledge switch.

    a. Alarm Silencing:

        1) Should the "Alarm Silence" button be pressed, all alarm signals shall cease operation.

        2) Signals shall not be silenced during alarm silence inhibit mode.

    b. System Reset:

1) The "System Reset" button shall be used to return to its normal state after an alarm condition has been remedied.

2) Should an alarm condition continue to exist, the system will remain in an abnormal state. System control relays shall not reset. The panel Priority Alarm LED shall remain on. These points will not require acknowledgement if they were previously acknowledged.

5. A manual evacuation switch shall be provided to operate the systems alarm notification appliances. Other control circuits shall not be activated. However, a fire alarm shall be processed as described previously.

6. Activation of an auxiliary bypass switch shall override the automatic functions either selectively or throughout the system.

7. Alarm and trouble conditions shall be immediately displayed on the control panel Alphanumeric display. If more alarms or troubles are in the system, the operator may scroll to display new alarms.

F. Supervision

1. There shall be adequate independently supervised and independently fused notification appliance circuits for alarm, horns, and flashing alarm lamps. Disarrangement conditions of any circuit shall not affect the operation of other circuits.

2. All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble.

3. Each independently supervised circuit shall include a discrete panel readout to indicate disarrangement condition per circuit.

4. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator.

2.02. MULTIPLE ADDRESSABLE NETWORK (MANET)

A. Communication with addressable devices: The system must provide communication with all initiating and control devices individually. All of these devices are to be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:

1. Alarm
2. Trouble
3. Open
4. Short
5. Ground
6. Device Fail/or Incorrect Service/detector in need of cleaning

B. All addressable devices are to have the capability of being disabled or enabled individually.

C. Addressable devices may be multi-dropped from a single pair of wires.

D. A Mapnet Isolator shall be required to isolate each zone of addressable devices. The isolator module shall operate as an addressable device with the same capabilities of enable, disable, and annunciation.

E. The communication format must be a poll/response protocol to allow t-tapping of the wire to addressable devices and be completely digital. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission protocol. Systems that do not utilize full digital protocol (i.e. that may use time pulse width methods to transmit data etc.) will not be acceptable.

F. Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact.

G. Wiring types will be approved by the equipment manufacturer. The system must allow up to 2,500 feet wire length to the furthest addressable device.

2.03. FIRE ALARM CONTROL PANEL (FACP)

A. Furnish and install a fire alarm control panel as shown on plans. Construction shall be modular with solid state, microprocessor based electronics. It shall display only those primary controls and displays essential to operation during a fire alarm condition. Although the keypad/keyboard can be used for control (firefighter/emergency) of the entire system; it shall only be used for maintenance purposes. Keyboards or keypads shall not be visible or required to operate the system during fire alarm conditions.

B. A local audible device shall sound during “Alarm,” “Trouble,” or “Supervisory” conditions. This audible device shall sound differently during each condition to distinguish one condition from another without having to view the panel. This audible device shall also sound differently during each keypress to provide audible feedback (chirp) to ensure the key has been pressed properly.

1. Primary Keys & Panel Display:

a. The control panel shall have a 2-line x 40 character liquid crystal display which shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keyboard activity.

b. The display shall support both upper and lower case letters. Lowercase letters shall be used for softkey titles and prompting the user. Uppercase letters shall be used for System Status information. A cursor shall be visible when entering information.

2. Function Keys

a. Additional field programmable function keys shall be provided to access status data for all system points. As a minimum, the status data shall include "Disable/Enable" status, Verification Tallies of Initiating Devices, Acknowledge Status, etc.

3. LED Supervision

a. All slave module LEDs shall be supervised for burnout or disarrangement. Should a problem occur, the panel shall display the module and the LED location numbers to facilitate location of that LED.

4. Panel Features

a. The fire alarm control panel shall allow for loading or editing special instructions and operating sequences as required. The FACP shall be capable of on-site programming to accommodate and facilitate expansion, building parameter changes or changes as required by local codes without the need to replace IC chips. All software operations are to be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in the memory.

b. The ability for selective input/output control functions based on ANDing, ORing, NOTing, timing and special coded operations is also to be incorporated in the resident software programming of the system.

c. To accommodate and facilitate job site changes, initiation circuits shall be individually configurable on site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring a non-latching circuit for an alarm verification circuit.

d. An operator, at the FACP, having a proper access level, shall have the capability to manually control the following for each log sensor:

1) Clear peak detection values
2) Enable or disable the point
3) Clear verification tally
4) Control a sensor's relay driver output
5) Change sensor sensitivity level

e. It shall be possible to program the control panel to automatically change the sensitivity settings of each analog sensor based on time-of-day and day-of-week (for example, to be more sensitive during unoccupied times and less sensitive during occupied periods). There shall be seven (7) sensitivity settings available for each photo sensor.

f. The control panel shall have the capability of being programmed for a pre-alarm or two-stage function. This function allows an indication to occur when, for example a 3% sensor reaches a threshold of 1.5% smoke obstruction.

g. At least 500 individually identified sensors as well as conventional initiating device and indicating appliance circuits shall be supported within a single FACP.

5. History Logging

a. The control panel shall have the ability to store a minimum of three hundred (300) events in an alarm log plus a minimum of 300 events in a separate trouble log. These evens shall be stored in a battery protected random access memory (RAM). Systems not having discrete alarm and trouble logging memory shall include an alternate supervised (i.e. floppy drive, tape cassette) historic recording method with battery backup. Real time and date shall accompany all history event recording.

6. Walk Test with History Logging

a. The system shall be capable of being tested by one person. While in testing mode, the alarm activation of an initiating device circuit shall be silently logged as an alarm condition in the historical data file. The panel shall automatically reset itself after logging of the alarm.

b. The momentary disconnection of an initiating or indicating device circuit shall be silently logged as a trouble condition in the historical data file. The panel shall automatically reset itself after logging of the trouble condition.

c. Optionally, the walk test sequence will have the capability of activating the alarm indicating appliances. If this option is selected, any momentary opening of an initiating or notification appliance circuit wiring shall cause the alarm indicating appliances to sound for four (4) seconds to indicate the trouble condition.

d. Should the walk test feature be on for an inappropriate programmable amount of time, it shall revert to the normal mode automatically.

e. The control panel shall be capable of supporting up to eight (8) separate testing groups whereby one group of points may be in a testing mode and the other (non-testing) groups may be active and operate as programmed per normal system operation. After testing is considered complete, testing data may be retrieved from the system in chronological order to ensure device/circuit activation.

f. Should an alarm condition occur from an active point, not in walk test mode, it shall perform all standard alarm sequences.

g. Suppliers of systems not having this feature as functionally specified above shall include a testing agreement meeting the requirements of NFPA 72H in their base bid quotation. As a minimum, two (2) years of scheduled testing shall be included.

7. System Trouble Reminder

a. Should a trouble condition be present with the system and the audible trouble signal silenced, the trouble signal shall resound at preprogrammed time intervals to act as a reminder that the fire alarm system is not 100% operational. Both the time interval and the trouble reminder signal shall be programmable to suit the Owner's application.

8. Access Levels

a. There shall be a minimum of four (4) access levels. Passcodes shall consist of up to ten (10) digits. Changes to passcodes shall only be made by authorized personnel. Systems not capable of password protected manual command operations shall provide key operated switches for these functions. Function key switches shall be keyed differently from any other keyed switches or locks used within the system.

b. In order to maintain security when entering a passcode, the digits entered will not be displayed. All key presses will be acknowledged by a local audible momentary tone.

c. When a correct passcode is entered, an "ACCESS GRANTED" message shall be displayed. The new access level shall be in effect until the operator leaves the keypad inactive for ten (10) minutes or manually logs out.

d. Should an invalid code be entered, the operator shall be notified with a message and shall be allowed up to three (3) chances to enter a valid code. After three (3) unsuccessful tries, an "ACESS DENIED" message shall be displayed.

e. Access to a level will only allow the operator to perform all actions within that level and all actions of lower levels, not higher levels.

f. The following keys/switches shall have access levels associated with them:

1) Alarm Silence
2) System Reset
3) Set Time/Date
4) Manual Control
5) On/Off/Auto Control
6) Disable/Enable
7) Clear Historical Alarm Log
8) Clear Historical Trouble Log
9) Walk Test
10) Change Alarm Verification

g. Acknowledge keys shall also require privileged access to acknowledge points. If the operator presses an acknowledge key with insufficient access, an error message will be displayed. The points with scroll with each key press to view the points on the list, but the points will not get acknowledged in the database.

2.04. EXTERNAL DEVICES

A. Remote LCD Annunciators

1. In entrance vestibule, main offices and where otherwise shown on drawings, provide and install flush mounted LCD annunciators. The annunciator shall communicate to the control panel over one twisted pair of wire and operating power shall be 24 VDC and be fused at the control panel. Point-wired annunciators will not be considered as equal. Adjacent to the annunciator provide a graphic floor plan.

2. The annunciators that are provided in the building vestibule shall have all control buttons programmed so that they are not operable. The one in the vestibule shall be annunciator only, with no controls.

   a. The LCD annunciator shall provide a common alarm and trouble circuit consisting of:

      1) Control pushbutton switches for: Alarm Silence, Alarm Acknowledge, Trouble Acknowledge, System Reset, Display Time and up to four (4) control keys for programmable operation duplicating the control panel switches. A key "enable" switch or password control function shall be provided to activate or deactivate the control switches.

      2) Tone Alert – Duplicated the control panel tone alert during alarm and trouble conditions.

      3) System Trouble LED.

      4) Power On LED.

      5) An 80 character LCD display. The top line of 40 characters shall be the point label and the second line shall be the device type identifier. The system alarm LED shall flash on the control panel and the remote annunciator until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone shall flash the system alarm LED on the control panel and remote annuciator. The LCD display shall show the new alarm information.

      6) Alarm silence LED.

   b. The annunciator's display shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.

   c. The display shall support both upper and lower case letters. Lowercase letters shall be used for softkey titles and prompting the user. Uppercase letters shall be used for System Status information. A cursor shall be visible when entering information.

d. Under normal conditions, the front panel shall display a "System is Normal" message and the current date and time.

e. Should an abnormal condition be detected, the appropriate LED (Alarm, Supervisory, or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

f. The LCD shall display the following information relative to the abnormal condition of a point in the system.

1) 40 character custom location label

2) Type of device (i.e. smoke, pull station, waterflow).

3) Point status (i.e. alarm, trouble).

3. To accommodate the facilitation of job site changes, the control switches shall have the capability to be programmed on site to provide for manual switch input operation other than their standard purpose.

B. Floor Plan

1. Adjacent to each annunciator and at the main control panel, provide a floor plan with the following:

a. ¾" x ¾" red colored, extruded, aluminum frame, connected at each of the corners with a screw corner bracket; similar to the type used for picture frames.

b. Provide plexiglass covering on front.

c. Provide metal back plate.

d. Provide for mounting with screws through the front. Predrill plexiglass front with smaller holes so that screws are captured inside the unit and cannot fall out, but can be attached into the wall using a narrow blade screwdriver or Allen wrench.

e. Floor plan of the building shall be shown on the floor plan graphic.

f. Each of the zones shall be clearly labeled.

g. The floor plan graphic shall be black with each zone indicated in black. Show all fire alarm devices in zone and show their location.

h. For multiple floors or larger buildings, provide additional displays, if required, so as to improve readability.

i. This unit is to be supplied by the contractor or fire alarm equipment supplier. Drawing of this unit must be shown in the review drawings.

C. Visual Flashing Lamps (Xenon Strobe) Dry Locations:

1. Visual indicating appliance shall comprise a Xenon flashtube and be entirely solid state. These devices shall be UL listed and comply with current ADA requirements, and be capable of either ceiling or wall mounting. Visual units shall incorporate a built-in reflector to improve lighting characteristics.

2. Provide candela level per NFPA.

3. The LEXAN lens shall be pyramid shaped to allow for better visibility. Provide vandal resistant unit. Visual units shall be incorporated as part of every horn assembly and shall be individually mounted where shown on drawings.

4. The location of the visual indicator is approximate. Install in the room, at any location, as long as the indicator can be viewed from all useable spaces within the room. Mount visual indicator where it does not conflict with other wall finishes or other equipment.

D. Audible/Visual Notification Alarm Appliance (horn/ strobe) dry location:

1. Visual units shall provide a common enclosure for the fire alarm audible and visual alarm devices. The unit shall be complete with a tamper resistant, Pyramidal shaped lexan lens with "Fire" lettering visible from a 180 degree field of view. The front panel or bezel which is constructed of UL Listed Noryl, may be inverted so that the lens is below the audible device.

2. Integral Xenon strobe shall provide candela as listed below and be adjustable from 1 to 3 flashes per second.

3. Provide candela level per NFPA 72.

4. Xenon strobe shall provide 4 wire connection to insure properly supervised in/out system connection. Unit shall be complete with all mounting hardware including backbox, for semi-flush mounting. For existing construction, surface mounted unit may be provided. All surface hardware shall be painted red. Visual unit shall be UL Listed for its intended purpose and comply with current ADA 1971 requirements. Units shall be vandal resistant.

E. Audible/Visual Notification Alarm Appliance (horn/strobe) Wet Location: Provide in exterior locations. Equipment to be same as listed above, except weatherproof location model.

F. Addressable Peripheral Devices: The system control panel, over its two wire multi-drop channel, must be capable of communicating with types of addressable devices specified below. Addressable devices will be located as shown on the drawings.

G. Addressable Pull Stations

1. Addressable pull stations will contain electronics that communicate the station's status (Alarm or Normal) to the control panel over two wires which will also provide power to the pull station. The address will be set on this station. The stations will be manufactured from high impact red Lexan. Lettering will be raised and painted white. The station will mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks. Pull stations shall be double action and identified for local use by raised white LOCAL lettering.

2. The front of the station is to be hinged to a backplate assembly and must be opened with a key to reset the station. The key shall be common with the control panels. Stations which use Allen wrenches or special tools to reset, will not be accepted. The station shall consist of high impact Lexan, red in color.

3. The addressable manual station shall be capable of field programming of its "address" location on an addressable signaling line circuit.

4. There shall be no limit to the number of stations, detectors or Zone Adapter Modules, which may be activated or "in alarm" simultaneously.

5. The addressable manual station shall be Underwriter's Laboratories, Inc. listed.

H. Smoke Sensors:

1. The smoke sensors shall be of the photoelectric type and shall communicate actual chamber values to the system control panel.

2. The smoke sensors and bases shall be listed to UL Standard 268 and documented compatible with the control equipment to which they are connected. The sensors shall be listed for both ceiling and wall mount applications.

I. Photoelectric Sensor Head:

1. The sensor shall be of the solid state photoelectric type and shall contain no radioactive material. They will use a pulsed infrared LED light source and be sealed against rear air flow entry.

2. The photoelectric type sensor shall be a plug-in unit which mounts to a twist-lock base.

3. The sensor shall fit into a base that is common with both the heat sensor and ionization type sensor and shall be compatible with other addressable detectors, addressable manual stations, and addressable Zone Adaptor Modules on the same circuit.

4. There shall be no limit to the number of sensors, stations or Zone Adaptor Modules which may be activated or "in alarm" simultaneously.

5. Each sensor will be capable of sensing up to (7) sensitivity levels ranging between .5% and 3.7%.

6. The photoelectric sensor shall have a fine 30 mesh insect screen.

7. The sensor electronics shall be completely shielded to protect against false alarms from EMI and RFI (Electromagnetic and Radio Frequent Interference).

J. Thermal (Heat) Sensor Head:

1. The thermal type sensor shall be a plug-in unit which mounted to a twist lock base.

2. The sensor shall be a combination rate of rise/fixed unit temperature sensor U.L. listed as a rate compensated heat detector.

3. The sensor shall fit into a base that is common with both photoelectric and ionization sensors and shall be compatible with other addressable detectors, addressable manual stations, and addressable Zone Adapter Modules on the same circuit.

4. There shall be no limit to the amount of sensors, stations or Zone Adapter Modules, which may be activated or "in alarm" simultaneously.

5. Each sensor is capable of operating at a selectable rate of rise operation of 15 or 20 Degrees Fahrenheit per minute and is self restorable.

6. Each sensor is capable of fixed temperature operation selectable for either 117 or 135 Degrees Fahrenheit, independent of the rate of rise setting.

7. Each sensor can be configured for utility monitoring and capable of sensing temperature between 32 and 158 Degrees Fahrenheit.

K. Addressable Sensor Bases:

1. Sensor bases shall be compatible with all models of sensors. Each base is capable of communicating sensor values to the panel if a "wrong device type" trouble condition is present. The panel will continue to monitor for alarms and troubles using the default setting for the wrong device until the proper type is installed or the program is changed.

2. Each sensor base shall contain a LED that will flash each time it is scanned by the control panel (once every 4 seconds). When the control panel determines that a sensor is in the alarm or a trouble condition, the control panel shall command the LED on that sensor's base to turn on steady indicating the abnormal condition. Sensors which do not provide a visible indication of an abnormal condition at the sensor location shall not be acceptable.

3. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.

   a. The sensor base shall annunciate power-on, alarm and trouble conditions locally at the base.

   b. In addition, where shown on plans, the sensor base shall remotely annunciate power-on, alarm and trouble conditions using a remote LED indicator.

4. Sensor Base with Relay:

a. Where shown on plans, for elevator smoke detectors, and for smoke detectors associated with smoke doors, the sensor base shall include a control relay for programmable function.

b. The relay shall not take any additional addressable device capacity.

c. The relay shall provide (2) sets of Form C contacts rated 3 amps and powered from the system 24 VDC and operate in battery standby.

d. Relay shall mount in same electrical box the sensor base is installed on.

e. Wire relay to interconnect with magnetic hold opens where shown on drawings. The smoke detector shall be configured such that the smoke detector will directly control the magnetic hold-open devices and will cause only those doors associated with the detector to close. All doors shall not close at once.

L. Fire Alarm Control Multiplex Operation (Miniplex):

1. The system shall be capable of providing multiplex operation by using the fire alarm control panel as a central processing unit (CPU) that provides Style 4 or Style 7 communications up to 31 remote transponders. All data communications wiring between the CPU and transponders shall be supervised for opens, shorts, and grounds. The remote transponders shall be capable of containing up to 31 selectable fire alarm control panel modules to provide the following functions:

a. Interface modules, each capable of communicating to up to 127 devices via the Multiple Addressable Peripheral detectors, smoke sensors, and other addressable initiating and control devices as described in Section 9.

b. Power supply and charger capable of providing 8 Amps of system power and capable of charging up to 50 AH batteries powered by 120 HVA, 60 Hz.

c. Initiating circuits for Style B or Style A operation.

d. Notification Appliance circuits for Style Y or Style Z.

e. Auxiliary control relay circuits with feedback to monitor circuit connection.

f. Isolator module to provide line isolation of shorted segments.

g. Input/Output Graphic Driver Interface.

h. Front panel mounted status indicating LEDs including with provision for selecting and changing LED color on-site.

i. Momentary switches with status indicating LEDs.

j. Three position (On-Off-Auto) maintained switches with status indicating LEDs.

k. Packaging shall include solid door with beige paint.

2.05. PROGRAMMABLE MODULES

A. Programmable Input Modules shall be the used for monitoring of waterflow, valve tamper, and non-addressable devices.

B. These modules shall be addressable and shall be provided for interfacing open and direct contact devices to the addressable signaling circuit.

C. Provide addressable output modules. These shall be for operating non-addressable devices, such as air handler starters, smoke dampers, security equipment, magnetic holders, and other devices requiring fire alarm system control.

D. For non-supervised control.

1. This type of addressable device will provide double pole double throw relay switching for loads up to 120 VAC. It will contain easily replaceable 2 amp fuses, one on each common leg of the relay.

2. The AM shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions. Should the AM become non-operational, tampered with, or removed, a discrete trouble signal, unique to the device, shall be transmitted to, and annunciated at, the control panel.

3. The AM shall be capable of being programmed for its "address" location on the addressable device signaling circuit. The AM shall be compatible with addressable manual stations and addressable detectors on the same addressable circuit.

4. All devices will be supervised for trouble conditions. The system control panel will be capable of indicating the type of trouble condition (open, short, device missing/failed). Should a device fail, it will not hinder the operation of other system devices. Should a problem occur on a particular wire run, it will not affect other wire runs.

2.06. ELEVATOR SHUNT TRIP

A. The intended function of elevator shunt-tip operation is to disable power to the elevator prior to elevator shaft or machine room sprinkler actuation.

B. Elevator shaft and machine room heat detectors shall be configured as follows:

1. Detectors shall be configured for FIXED TEMPERATURE-ONLY OPERATION.

2. Detectors shall have a lower actuation temperature than the sprinkler heads within the shaft and machine room. The Electrical Contractor shall coordinate this information with the Fire Protection Contractor. Detector shall be installed within 2′-0″ of sprinkler head.

3. Detectors shall have a lower response-time index than the sprinkler heads within the shaft and machine room. The Electrical Contractor shall coordinate this information with the Fire Protection Contractor.

C. If the alarmed heat detector is located within the elevator shaft, or within the machine room, an Addressable Control Module or a supervised remote relay shall be actuated. The Control Module/Relay shall be located within three (3) feet of the shunt-trip breaker, and shall interrupt power to the elevator. If the elevator is hydraulic, a second Control Module Contract shall allow elevator auxiliary power to lower the elevator to the proper level. Auxiliary power, if needed, shall be furnished by the Elevator Contractor.

D. The Power Sources, which is used to actuate each elevator shunt-trip circuit breaker, shall be individually supervised by the FACP.

2.07. MOUNTING OF SMOKE DETECTORS

E. Smoke detectors shall not be installed until final room finishes and carpeting have been laid. As an option to this, the contractor may install the smoke detector, but it must be protected by a plastic bag to prevent dust entering the smoke detector. Install the smoke detectors in this manner to prevent erroneous alarms. If smoke detectors are installed prior to final room finishes being completed and floor finishes being installed, this contractor shall bear the expensive of returning the smoke detectors to the factory for cleaning and recalibration.

2.08. SPRINKLER SYSTEM SUPERVISORY SERVICE

A. The control panel shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.

B. The activation of any standpipe or sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED at the control panel and the FAAP. The panel shall provide differentiation between valve tamper activation and opens and/or grounds on the initiation circuit wiring.

1. Each Valve Tamper Switch shall be individually monitored, except for pairs of valves associated with the "Double Check Valve." The Descriptors, which are used to describe these tamper switches, shall identify the function or sprinkler zone associated with the valve.

2. Each Flow Switch and Pressure Switch, which are used to indicate discharge, shall be individually monitored, and shall cause the actuation of the proper Alarm Sequence corresponding to the location of the Sprinkler Zone. The Descriptors, which are used to describe these flow and pressure switches, shall identify the associated sprinkler zone. In other words – describe where the water should be going, not the location of the flow or pressure switch.

3. The function on each valve, flow switch, and pressure switch, associated with the Fire Protective Sprinkler System shall be available, upon request by the successful Electrical Bidder, from Owner, the Fire Protection Engineer or Fire Protection Contractor.

4. The fire pump (if applicable) shall be monitored for presence of power, loss of power and phase reversal.

3. PART 3 – EXECUTION

3.01. EXAMINATION

A. Verify surfaces and areas are ready to receive work.

B. Verify field measurements are accurate and shown on drawings.

C. Verify proper power connections are installed.

D. Proceed with installation only after unsatisfactory conditions are corrected.

E. All wiring shall test free from grounds and shorts.

3.02. FIELD MEASUREMENTS

A. Field verify proper mounting heights of all devices.

B. Field verify surfaces which equipment will be located. Verify adequate room for recessed equipment. Adjust locations to satisfy field measurements.

C. Mounting heights as shown on drawings and details. Coordinate final locations with on-site architect prior to rough-in.

3.03. DELIVERY, STORAGE & HANDLING

A. Receive, sign for, and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.04. INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.

2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment, and written notice received by ESC from Architect stating that these conditions exist at building site.

4. Install power supplies as required based on equipment per manufacturer.

B. Cleaning:

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.

2. All appearance defects shall be carefully and professionally touched up so that the equipment is in “factory new” condition.

3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

C. System Wiring

1. The system wiring and installation shall be in compliance with applicable codes, project drawings and as required by the manufacturer. All wiring shall be color coded, tagged and checked to assure that it is free from shorts and grounds. Provide record drawings of installation.

2. Note: Electrical contractor shall provide duxseal at each smoke detector to seal the conduit.

D. Raceways

1. All wiring shall be in a conduit system separate from other building wiring. See Section 16111 - Conduit and Surface Raceways for specifications.

2. All wiring shall be in minimum ½" steel raceway.

3. 40% fill factor shall be applied to all conduit sizes.

4. The contractor shall size conduit and boxes by circular mil size of each cable in each conduit or box. The circular mil sizing can be found on the manufacture's spec sheet, then use the NEC codebook to make calculation to follow NEC Table 370-16(a) for box fill and Chapter 9 for conduit fill.

5. There shall be no sharp edges with installed materials.

6. Use only identified conduit entries or request approval for other penetrations in cabinets; (certain areas require clear space for interior components / batteries). Cabinet shall be grounded to either a cold water pipe or grounding rod.

7. Existing conduit and surface metal raceway that is ½” in size or larger may be reused if found to have adequate space provided that it only serves the Fire Alarm system and doesn’t contain any AC wiring. All existing conduit that is reused MUST be brought up to the current State of Wisconsin Electrical Code and Approved for usage by the Engineer prior to work being done.

8. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellom grips may be used to spread the strain over a longer length of cable.

9. It is the contractors' responsibility to survey the site and include all necessary costs to perform the installation as specified. This includes any modifications required to route and conceal horizontal distribution wiring.

10. Beginning installation means contractor accepts existing conditions.

11. Contractor shall furnish all required installation tools to facilitate cable pulling without damage to the cable jacket. Such equipment is to include, but not limited to, sheaves, winches, cable reels, cable reel jacks, duct entrance tunnels, pulling tension gauge and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. Makeshift devices, which may move or wear in a manner to pose a hazard to the cable, shall not be used.

12. All cable shall be pulled by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to insure that the maximum tensile load for the cable as defined by the manufacturer is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of a "break-away" or other approved method.

13. The contractor will be responsible for identifying and reporting to the Site Coordinator(s) any existing damage to walls, flooring, tiles and furnishings in the work area prior to start of work. The Contractor must repair all damage to interior spaces caused by the installation of cable; raceway or other hardware. Repairs must match preexisting color and finish of walls, floors and ceilings. Any contractor-damaged ceiling tiles are to be replaced to match color, size, style and texture.

14. Where unacceptable conditions are found, the Contractor shall bring this to the attention of the construction supervisor immediately. A written resolution will follow to determine the appropriate action to be taken.

15. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work. During pulling operation an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as the feed cable and operate pulling machinery.

16. Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 standards. Manufacturer's recommendations shall be a part of the cable submittal. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than recommended dimension shall not be installed.

17. Avoid abrasion and other damage to cables during installation.

18. Pulling Lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to the cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.

19. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

E. Conductors

1. All wire and cable associated with this system shall be as required by the equipment manufacturer. The following information is intended for estimating purposes only. However, the minimum wire gauges and colors specified shall be strictly adhered to. All cable shall be installed as per NEC Article 760.

2. All signaling, initiation and notification circuit cabling shall be listed Type FPL (300V) in accordance with NEC article 760."

3. All cables and wires #14 AWG and larger shall be stranded.

4. Fire alarm wiring shall be held in place at the device box, by means of a two-screw connector, (do not use squeeze or crimp type connectors).

5. All wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, disarrangement of any components, any open circuits or grounds in the system, an audible and visual trouble signal shall be activated until the system is restored to normal.

6. All conductors shall be color-coded. Coding shall be consistent through out the facility. Green wire shall be used only for equipment ground.

7. Each Fire Alarm Control Panel shall be connected to separate dedicated branch circuit from the building emergency panel, maximum 20 amperes. Circuit shall be labeled as "FIRE ALARM". The breaker shall be pained red and cap-locked.

8. Power wiring for Fire Alarm Control Panel, Annunciator Panel, and Remote Fire Command Center shall be #12 AWG.

9. Fire Alarm Control Panel shall have #6 AWG green equipment ground wire.

10. Where fire alarm circuits enter or leave a building, additional transient 75 to 90 volt gas tube protection shall be provided for each conductor.

11. Leave 8-inch wire tails at each device box and 36-inch wire tails at the Fire Alarm Control Panel and Remote Annunciator Panel(s).

12. Cable for Intelligent detector Loops shall be 18 to 12 AWG twisted pair with a shield jacket installed in ½" conduit. Shield continuity must be maintained and connected to earth ground only at the control panel.

13. SLC wiring must not be in the same conduit with AC power wiring or other high current circuits. T-taps or branch circuit connections are allowed for all class B SLCs.

14. Cable for RS 232-c devices (CRT, PRINTER) shall be dual pair twisted- shielded.

15. Cable for RS 485 devices (Remote Annunciators) shall be twisted-shielded pair (Belden 9841 or equivalent) for the data signal. Power wiring shall be 12 AWG.

16. All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes shall be red and labeled "FIRE ALARM SYSTEM" or “FA” by decal or other approved markings.

17. Horn and strobe circuits shall have separate conductors, and shall operate independently of each other.

18. Horn wiring shall be #14 AWG minimum or as recommend by manufacturer.

19. Strobe wiring shall be #14 AWG minimum or as recommend by manufacturer.

20. Tray cable is not acceptable for use as fire alarm system wiring installed in conduit.

F. Grounding

1. All equipment shall be grounded in accordance with NEC, these specifications and drawings, and the equipment supplier’s recommendations.

   a. Each cabinet frame shall be grounded. Equipment cabinets shall be bonded directly to the building electrode grounding.
   b. All exterior panels of cabinets shall be bonded to the cabinet frame.
   c. All equipment installed in a cabinet shall be bonded to the cabinet frame.

G. Mounting Heights

1. Mounting heights:

   a. Fire alarm pull station: 42" to center
   b. Fire alarm signals and strobes: 80" above the floor (shall be to the highest point in the space i.e. above highest riser level in Band rooms, highest floor level in Auditoriums, etc.) to bottom or 6" below the ceiling, whichever is lower.
   c. Fire Alarm Annunciators: 48” to bottom
   d. Fire Alarm Control Panel: Mount such that the top of the fire alarm control panel is not higher than 6’-0”.
   e. Floor plan graphic: Adjacent to fire alarm annunciators.

H. Programming

1. All programming that is required for installation shall be done by this contractor. The contractor shall assume that his vendor is to meet with the owner to determine if there are any extraordinary programming circumstances. The supplier shall go over the entire sequence of operation of the fire alarm panel and explain what the various programming sequences are.

I. Interconnection of Fire Alarm to Other Systems

1. The fire alarm system shall be interconnected to the following systems:

a. Alarm dialer for master monitoring system furnished under another portion of this project.

J. Junction Boxes

1. Provide fire alarm pull and junction boxes per specification Section 16195.

K. Final Testing

1. The completed fire alarm system shall be fully tested in accordance with NFPA by the Contractor in the presence of the Owner's representative and the Engineer. Upon completion of a successful test, certify in writing to the Owner.

2. All wiring shall test free from all grounds and shorts.

3. The completed system shall be tested in accordance with N.F.P.A. Standard 72H. Provide a certified test report from the manufacturer's representative that the system complies with NFPA and State codes. All technicians performing work on this project shall be factory trained and at minimum, Nicet level two certified in fire alarm systems.

4. Fill out the fire alarm system checklist included as a part of this specification. This checklist shall be included with the final O&M operation manual and will be required prior to final payment being made on this equipment.

3.05. OWNER TRAINING

A. Provide complete operator training for the Owner's personnel.

B. Provide two (2) four hour training sessions on consecutive days at times set by the Owner. These should be scheduled as part of the Owner's pre-occupancy training.

C. Provide video tape training which can be used by the Owner for training new employees. This tape shall be carefully organized and segmented so that training may be given on the complete system, or on specific functions as may be appropriate.

D. Use submitted Operations & Maintenance manuals as reference during this demonstration and tour.

E. Have Owner sign certificate stating that he/she has received instruction on the fire alarm equipment.

3.06. SPARE EQUIPMENT (NONE)

END OF SECTION 16721

SECTION 16740
TELEPHONE AND DATA CABLING SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes wire, cable, connecting devices, installation, and testing for wiring systems to be used as signal pathways for voice and high speed data transmission.

B. Furnish and install complete with all accessories an existing Campus Cabling System (CCS). The CCS shall serve as a vehicle for transport of data, video, and voice telephony signals as indicated on the contract drawings and described herein.

C. The interconnect wiring to the building or Main Telecommunications Room and the cross connect wiring will be provided by the telephone company. Installation, termination and identification of wiring between workstations and station outlets to the TRs and the ERs shall be considered part of the contractors work.

D. Wiring utilized for data, video, and voice communications shall originate at owner designated hubs and concentrator location. The racks will be located at the Telecommunications Equipment Room (ER), the Main Cross-connect (MC), the Intermediate cross-connect (IC), and/or the Telecommunications Room (TR) location(s). Wiring, terminations, patch panels, terminal panels and punch down blocks required for a complete pathway system between these designated demarcation points and outlet locations designated on the contract drawings shall be considered part of the contract. Telecommunication Outlets (TO) shall be furnished, wired and installed by the CCS system contractor.

E. All cables and terminations shall be identified at all locations.

F. All cables shall be labeled with an alphanumeric sequence identifier at all termination locations.

G. All copper cable terminations shall comply with, and be tested to ANSI/TIA/EIA 568-B standards for Category 5E and/or Category 6 installations.

H. All cables at the work area shall terminated on specified modular jacks and mounted on one, two or three gang wall plates equipped as shown on the drawings.

1.2 DEFINITIONS

A. Campus Cabling System (CCS): A CCS is defined as all required equipment, including all cabling with hardware, termination/punchdown blocks, [cross connect wiring], fiber patch cables, and telecommunication outlets with specified modular jacks. All equipment shall be installed and configured to provide computer data, video capabilities, and voice connectivity from each work area to the network file server or voice network/switch designated as the service point of the local area network.

B. Work Area: The connection point between the (TO) and the electronic equipment in the work area. It consists of cords, adapters, handsets, computers, printers, and other transmission electronics.

C. Horizontal Subsystem: The Horizontal system provides connections from the horizontal cross connect to the Telecommunication Outlets (TOs) in the work area. It consists of the horizontal transmission media, the associated connecting hardware terminating this media and individual outlets in the workarea. Each floor of a building is served by its own Horizontal Subsystem.

D. Riser Backbone: The Riser Backbone system links the Main Cross connect (MC) in the equipment room to Intermediate Cross connects (IC); horizontal cross connects in the Telecommunications Rooms (TR) and Telecommunications Equipment Room (ER). It consists of the backbone transmission media between these locations and the associated connecting hardware terminating this media. It is normally installed in a star topology.

E. Campus Backbone: A Campus Backbone is used when a distribution system encompasses more than one building. The components and cables that provide the link between buildings constitute the Campus Backbone. This system includes the backbone transmission media, associated connecting hardware terminating this media, and electrical protection devices to mitigate harmful voltages when the media is exposed to lightning and/or power surges.

F. EMI: Electromagnetic interference

G. IDC: Insulation displacement connector

H. LAN: Local area network

I. PVC: Polyvinyl chloride

J. UTP: Unshielded twisted pair

1.3 CODES AND STANDARDS

A. NECA/BICSI #568-2006 Installing Commercial Building Telecommunications Cabling

B. TIA/EIA-568-B.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements – (May 2001)

C. TIA/EIA-568-B.1-1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements - Addendum 1 – Minimum 4-Pair UTP and ScTP Patch Cable Bend Radius - (May 2001)

D. TIA/EIA-568-B.1-2 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements Addendum 2 – Grounding and Bonding Requirements for Screened Balanced Twisted-Pair Horizontal Cabling - (February 2003)

E. TIA/EIA-568-B.1-3 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements Addendum 3 – Supportable Distances and Channel Attenuation for Optical Fiber Applications by Fiber Type - (February 2003)

F. TIA/EIA-568-B.1-4 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements > Addendum 4 – Recognition of Category 6 and 850 nm Laser Optimized 50/125 μm Multimode Optical Fiber Cabling - (February 2003)

G. TIA/EIA-568-B.1-5 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements Addendum 5 – Telecommunications Cabling for Telecommunications Enclosures – (March 2004)

H. TIA/EIA-568-B.1-7 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements Addendum 7 - Guidelines for Maintaining Polarity Using Array Connectors – (January 2006)

I. TIA/EIA-568-B.2 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components - (December 2003)

J. TIA/EIA-568-B.2-1 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 1 – Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling - (June 2002)

K. TIA/EIA-568-B.2-2 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 2 – Revision of Sub-clauses - (December 2001)

L. TIA/EIA-568-B.2-3 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 3 – Additional Considerations for Insertion Loss & Return Loss Pass/Fail Determination - (March 2002)

M. TIA/EIA-568-B.2-4 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 4 – Solderless Connection Reliability Requirements for Copper Connecting Hardware - (June 2002)

N. TIA/EIA-568-B.2-5 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 5 – Corrections to TIA/EIA-568-B.2 – (January 2003)

O. TIA/EIA-568-B.2-6 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 6 – Category 6 Related Component Test Procedures – (December 2003)

P. TIA/EIA-568-B.2-11 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 11 - Specification of 4-Pair UTP and SCTP Cabling – (December 2005)

Q. TIA/EIA-568-3 Optical Fiber Cabling Components Standard - (April 2002)

R. TIA/EIA-568-3.1 Optical Fiber Cabling Components Standard – Addendum 1 – Additional Transmission Performance Specifications for 50/125 μm Optical Fiber Cables – (April 2002)

S. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces -(October 2004)

T. TIA-598-C Optical Fiber Cable Color Coding - (January 2005)

U. TIA/EIA-606-A Administration Standard for Commercial Telecommunications Infrastructure - (May 2002)

V. J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications - (October 2002)

W. TIA-758-A Customer-owned Outside Plant Telecommunications Infrastructure Standard – August 2004

X. ANSI/TIA/EIA 862 Building Automation Systems Cabling for Commercial Buildings, April 11, 2002

Y. Underwriters Laboratories (UL®) Cable Certification and Follow Up Program.

Z. National Electrical Manufacturers Association (NEMA).

AA. American Society for Testing Materials (ASTM).

BB. National Electric Code (NEC®), Latest Issue

CC. Institute of Electrical and Electronic Engineers (IEEE).

DD. UL Testing Bulletin.

EE. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Firms shall be engaged in the manufacture of products and materials of types and sizes required, and whose products have been in satisfactory use in similar service for not less than five years.
2. The products specified in this specification shall be supplied by a single manufacturer, with the exception of data racks and other hardware that is not defined as part of the channel test configuration by ANSI/TIA/EIA 568-B.
3. Manufacturer shall be ISO 9001 Certified.

B. Contractor's Qualifications:

1. Firms shall have at least five years of successful installation experience with projects utilizing products and materials similar to that required for this Project.
2. An experienced installer and project manager who is a registered communication distribution designer certified by the Building Industry Consulting Service International (BICSI), and certified by the manufacturer for the installation of the cabling specified in this Section.
3. The selected contractor shall provide the installation of this system and shall be certified by the manufacturing company in all aspects of design, installation and testing of the products described herein.
4. The contractor shall utilize the authorized manufacturer components and distribution channels in provisioning this Project.
5. The contractor shall be in compliance with all federal, state and local statutes regarding qualifications of firms.
6. The contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.
7. The contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical systems, Category 5E systems, and Category 6 copper premise distribution systems.
8. The contractor shall have personnel who are adequately trained in the usage of such tools and equipment.

C. Comply with NFPA 70 (latest edition).

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 SUBMITTALS

A. Product Data: Include data on features, ratings, and performance for each component specified.

B. Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Submittals shall include all items called for in PART 2 – PRODUCTS of this document and the manufacturers cut sheets for the following:

1. All connectors and required tooling.
2. All termination system components for each cable type.
3. All ER, MC, IC and TR equipment frame types, hardware (and LAN equipment if applicable).
4. All grounding and surge suppression system components.
5. All test equipment to be used for fiber and copper channels
6. A technical data sheet showing manufacturer's Guaranteed Channel Performance over the full swept frequency range.
7. Technical data sheets shall include the physical specifications as well as the following electrical and transmission characteristics:
    a. Mutual Capacitance
    b. Impedance
    c. DC Resistance
    d. Attenuation
    e. Worst Pair-to-Pair Near End Crosstalk
    f. Power Sum Near End Crosstalk
    g. ELFEXT
    h. Power Sum ELFEXT
    i. Return Loss
    j. Manufacturer's Instructions
8. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
9. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

D. Contractor shall submit the following documents with project proposal:

1. A letter of approval from the manufacturer indicating completion of pre-qualification requirements.
2. Training certificates for design, engineering and installation of the proposed products.

E. Vendor shall submit, to the Engineer/Owner, all factory test information prior to installation. If equivalent product(s) are substituted, the equivalent product(s) must show demonstrated and documented equivalence to the product(s) specified.

F. Shop Drawings: Include dimensioned plan and elevation views of components. Show access and workspace requirements.

1. System labeling schedules, including electronic copy of labeling schedules, as specified in Part 3, in software and format selected by Owner.

G. Samples: For workstation outlet connectors, jacks, jack assemblies, and faceplates for color selection and evaluation of technical features.

H. Product Certificates: Signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.

I. Qualification Data: For firms and persons specified in "Quality Assurance" Article. Provide evidence of applicable registration or certification.

J. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

K. Maintenance Data: For products to include in maintenance manuals specified in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Where recommended by the equipment supplier, deliver equipment in fully enclosed vans after specified environmental conditions have been permanently established in spaces where equipment is to be placed. The products accepted on the site shall be wrapped in factory packing, and shall be inspected for damage prior to acceptance.

C. Store equipment in clean, dry with non-condensing environments that are controlled within manufacturer=s ambient tolerances for non-operating equipment. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

D. Handle equipment carefully to prevent damage, breaking, and scoring. The contractor shall not install damaged units or components; replace with new.

E. Equipment furnished by others. The contractor shall be responsible for receiving, uncrating, inspecting, storing, and installing of Division 26 equipment listed as furnished by others.

1.7 SPARE PARTS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cable Jacks: 10% of each type and color installed, but not less than one of each type or color.
2. Device Plates: 10% of each type installed, but not less than one.
3. Patch Cords: 10% of each type installed or provided to owner, but not less than one of each type.

1.8 WARRANTY

A. Material Guarantee: The wiring vendor (installer) shall guarantee at the time of the bid that all Category 5E, Category 6 cabling and components meet or exceed specifications (including installation) of ANSI/TIA/EIA-568-B.1, 568-B.2, 568-B.3 and 569.

B. Material Provided: The successful wiring vendor (installer) shall be certain that all correct parts are ordered per Products Section of this document and installed in accordance with manufacturers design and installation guidelines. Vendor shall submit complete parts and part numbers to Engineer/Owner prior to installation of equipment.

C. Warranty Documentation: Warranty shall be for 5 years.

1. Complete documentation regarding the manufacturer's warranty shall be submitted as part of the submittal process. This shall include, but is not limited to a sample of the warranty that shall be provided to the owner when the installation is complete and documentation of the support procedure for warranty issues.

1.9 MAINTENANCE

Not Applicable

1.10 COORDINATION

A. Coordinate Work of this Section with the existing telephone service, telephone/data locations and Owner's technical personnel.

1. Meet jointly with representatives of the local exchange carrier and Owner's representatives to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute record to other participants.
3. Adjust arrangements and locations of distribution frames, patch panels, and cross connects in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amp Connect
2. Berk-Tek and Ortronics (Net Clear)
3. Belden IBDN
4. Hubbell and Mohawk (Sure bit)
5. Leviton and Superior Essex (Next lad)
6. Sumitomo Electric – Future Flex
7. The Siemon Company
8. Pre approved equal

B. Unspecified equipment and material

1. Any item of equipment or material not specifically addressed on the drawings or in this document and required to provide a complete and functional CCS installation shall be provided in a level of quality consistent with other specified items.

C. Cabling Part numbers: The following catalog numbers are based upon communications cable and termination components manufactured by Amp Netconnect. Subject to the available manufacturers list above, contractor shall provide equivalent equipment by the listed manufacturers.

1. Category 5e UTP cables

a. (Plenum Rated): Colors Blue for data, Tan for phone.

(1) Amp Netconnect #219513-X

b. (Riser Rated): Colors Blue for data, Tan for phone.

(1) Amp Netconnect #219538-X

2. Category 6 FTP (shielded) cables
   a. (Plenum Rated): Colors Blue for data, Tan for phone.
      (1) Amp Netconnect #1499416-X
   b. (Riser Rated): Colors Blue for data, Tan for phone.
      (1) Amp Netconnect #1499389-X
3. Terminal Patch Panel (CAT-5e cables)
   a. Amp Netconnect #406331-1
4. Connectors, Jacks, Plates:
   a. Jacks B compatible with selected cable manufacturer throughout. Color: Grey for data, White for telephone.
      (1) CAT6 Modular Jack: Amp Connect #1375055-X (unshielded)
      (2) CAT6 Modular Jack: Amp Connect #1375118-1 (shielded)
      (3) CAT 5e Modular Jacks: Amp Netconnect #1375191-X unshielded)
      (4) CAT 5e Modular Jacks: Amp Netconnect #1375189-1 (shielded)
   b. Fact Plates B Color: White 4 -position to mount on single gang outlet box and [6] [12] position to mount on a 2-gang outlet box. Provide blank fill modules as required (to match plate) to close up all unused positions.
      (1) Amp Netconnect #557505-X (2-position)
      (2) Amp Netconnect #558088-X (4-position)

D. Equivalent products
1. Equivalent product(s) may be considered for substitution for those products specified, however, the equivalent product(s) must be approved and show demonstrated and documented equivalence to the product(s) specified.
2. Documentation shall include, but is not limited to: product samples, data sheets, and actual test data.
3. The request for product substitution, and supporting documentation, must be submitted, in writing, prior to submitting the bid.
   a. Written approval for product substitution must be submitted with the bid.

2.2 SYSTEM REQUIREMENTS

A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

B. Guaranteed Performance
1. Category 5E Guaranteed Channel Performance
   a. The Category 5E, 4 pair UTP channel shall consist of all cable and components with up to two connections that comprise the full 100 meter (328 feet) length circuit from the Hub/Server/LAN Electronics port located in the ER and TR rooms to the TO location Work Station inclusive of all patch cables and work station cables.
   b. The Category 5E, 4 pair UTP channel shall be capable of providing stable and continual performance up to 155.5MHz over the entire swept frequency.

c. The Category 5E channel shall support emerging high-bandwidth applications, including 1000 Base-T Ethernet, Multi-Tasked Split Screen Computing, Virtual Holographic Video Conferencing, Instant Access Telemedicine, 3D CAD/CAM Engineering, Internet-Intranet Communications/Commerce, ATM as well as all 77 channels (550 MHz) of analog broad band video.

d. All copper cable and apparatus shall exceed the Category 5/Class E Channel Performance Specification.

e. The copper cable and apparatus channel performance shall be measured over the full 100 meters (328 feet) length and include 4 connection points.

f. A single manufacturer shall be responsible for all of the Category 5E cable and all Category 5E channel components.

g. The manufacturer shall warrant the Category 5E channel cable, components, and applications for a minimum period of [10] [15] [20] years.

h. The 5 -year warranty shall be a transferable warranty and include all labor to replace any defective components as well as the component replacement.

i. The guaranteed channel performance requirements of the Category 5E Channel with cable, cords, outlets and four (4) connections as compared to standard Category 5 shall apply to worst-case 100-meter channels using 4-pair Category 5E horizontal cable and shall be as follows:

Electrical Parameter (1 – 155.5MHz)	Guaranteed Margins to Category 5E / Class D Channel Specifications
Insertion Loss	5.0 %
NEXT	3.0 dB
PSNEXT	5.5 dB
ELFEXT	4.5 dB
PSELFEXT	5.5 dB
Return Loss	1.0 dB

Category 5E Guaranteed Channel Performance Specifications:

Freq (MHz)	Atten (dB)	pr-pr NEXT (dB)	ACR (dB)	PS NEXT (dB)	PS ACR (dB)	pr-pr ELFEXT (dB)	PS ELFEXT (dB)	Return Loss (dB)	Phase Delay (ns)	Delay Skew (ns)
1	2.1	63.0	60.9	62.5	60.4	61.8	59.8	18.0	580	30
4	4.2	56.6	52.4	56.2	52.0	49.8	47.8	18.0	562	30
8	6.0	51.6	45.6	51.2	45.2	43.8	41.8	18.0	557	30
10	6.7	50.0	43.3	49.6	42.9	41.8	39.8	18.0	555	30
16	8.6	46.6	38.0	46.2	37.6	37.8	35.7	18.0	553	30
20	9.7	45.0	35.4	44.6	34.9	35.8	33.8	18.0	552	30
25	10.9	43.4	32.5	42.9	32.1	33.9	31.9	17.0	551	30
31.25	12.2	41.8	29.5	41.3	29.1	31.9	29.9	16.0	550	30
62.5	17.7	36.6	19.0	36.1	18.4	25.9	23.9	13.1	549	30
100	22.8	33.1	10.3	32.6	9.8	21.8	19.8	11.0	548	30
125	25.8	31.5	5.7	30.9	5.1	19.9	17.9	10.1	547	30
155.5	29.1	29.8	0.7	29.2	0.1	18.0	16.0	9.1	547	30

2. Category 6 Guaranteed Channel Performance

a. All copper cable and apparatus shall conform to the Category 6 Channel Performance Specification.

b. The copper cable and apparatus channel performance shall be measured over the full 100 meters (328 feet) length and include 4 connection points.

c. The specifications for the 4 pair UTP Category 6 channel are divided into two primary groups based upon high performance and premium performance cable. The Category 6 channel shall consist of all cable and components with four connections that comprise the full 100 meter (328 feet) length circuit from the Hub/Server/LAN Electronics port located in the ER and TR rooms to the TO at the Work Station inclusive of all patch cables and work station cables.

d. The Category 6, 4 pair UTP channel shall support emerging high-bandwidth applications, including 1 Gbps Ethernet, potentially 1.2 Gbps ATM and 2.4 Gbps ATM, Multi-Tasked Split Screen Computing, Virtual Holographic Video Conferencing, Instant Access Telemedicine, 3D CAD/CAM Engineering, Internet-Intranet Communications/Commerce, as well as all 77 channels (550 MHz) of analog broad band video.

e. The Category 6 cable and Category 6 channel components shall be manufactured by a single manufacturer. The manufacturer shall warrant the Category 6 channel cable, components, and applications for a minimum period of [10] [15] [20] years.

f. The [10] [15] [20] year warranty shall be a transferable warranty and include all labor to replace any defective components as well as the component replacement.

g. The Category 6 channel with four (4) connections shall have a minimum of 10dB Attenuation to Crosstalk Ratio (ACR), across the full frequency range of 1MHz - 149.1MHz. At no point across the frequency range of 1MHz - 149.1MHz shall the ACR drop below 10dB.

h. The Delay Skew on the 100 meter channel shall not exceed 30 ns.

i. The Category 6 cable and components shall be electrically backward compatible with existing Category 3, 5, 5E plus future networks.

j. The Category 6 components shall be engineered and manufactured to compensate for any CAT 3, 5 or 5E component crosstalk and shall provide at least CAT 3, 5 or 5E performance in all of the customer's existing installed base of voice/data/video.

k. The Category 6 cable and components shall be physically compatible with existing installed base of equipment.

l. The Category 6 cable and components shall not require special cords, specialty tools or special installation requirements.

m. The guaranteed channel performance requirements of the Category 6 Channel described above with cable, cords, outlets manufactured by the same manufacturer and four (4) connections for 100 meters shall be as shown in the following tables:

Guaranteed Channel Performance Specifications for Category 6 Systems												
Frequency (MHz)	1	4	8	10	16	20	25	31.25	62.5	100	200	250
Insertion Loss (dB)	2.1	3.9	5.4	6.1	7.7	8.7	9.7	10.9	15.8	20.4	30.3	34.5
NEXT (dB)	69.0	67.0	62.2	60.6	57.2	55.6	54.0	52.4	47.4	43.9	38.8	37.1
ACR (dB)	66.9	63.2	56.7	54.5	49.5	47.0	44.3	41.5	31.6	23.5	8.5	2.6
PSNEXT (dB)	67.5	66.0	61.1	59.5	56.1	54.5	52.8	51.2	46.1	42.6	37.4	35.7
PSACR (dB)	65.4	62.1	55.7	53.4	48.4	45.8	43.1	40.3	30.3	22.1	7.1	1.2
ELFEXT (dB)	67.3	55.2	49.2	47.3	43.2	41.2	39.3	37.4	31.3	27.3	21.2	19.3
PSELFEXT (dB)	66.3	54.2	48.2	46.3	42.2	40.2	38.3	36.4	30.3	26.3	20.2	18.3
Return Loss (dB)	21.0	21.0	21.0	21.0	20.0	19.5	19.0	18.5	16.0	14.0	11.0	10.0
Delay (ns)	580	562	557	555	553	552	551	550	549	548	547	546
Delay Skew (ns)	30	30	30	30	30	30	30	30	30	30	30	30

Note: The table provides reference values only. All parameters comply with the governing equations given below over the entire frequency range. All values and equations apply to worst-case channels utilizing four-pair High Performance E series cables with full cross-connects, consolidation points and work area outlets (4 connectors in a channel) for any channel lengths up to 100 meters.

Electrical Parameter (1 - 250MHz)	Guaranteed Margins to draft Category 6 / Class E channel Specifications
Insertion Loss	4 %
NEXT	4 dB
PSNEXT	5.5 dB
ELFEXT	4 dB
PSELFEXT	6 dB
Return Loss	2 dB

(1) Governing Equations for 6-Connection High Performance Category 6 Channels (1-250MHz):

$$Insertion\ Loss \le 1.8472 \times \sqrt{f} + 0.0166 \times f + \frac{0.1958}{\sqrt{f}} + 2.88 \times 10^{-4} \times f^{1.5}$$

$$NEXT \ge -\left[20 \times \log\left(1.2162 \times 10^{-4} \times f^{0.75} + 2.5179 \times 10^{-5} \times f\right)\right]$$

$$PSNEXT \ge -\left[20 \times \log\left(1.2882 \times 10^{-4} \times f^{0.75} + 3.3576 \times 10^{-5} \times f\right)\right]$$

$$ELFEXT \ge -\left[20 \times \log\left(4.3367 \times 10^{-4} \times f\right)\right]$$

$$PSELFEXT \ge -\left[20 \times \log\left(4.8658 \times 10^{-4} \times f\right)\right]$$

$$RL \ge 21,\ 1 \le f < 10\ MHz; \quad RL \ge 26 - 5 \times \log(f),\ 10 \le f < 40\ MHz; \quad RL \ge 34 - 10 \times \log(f),\ 40 \le f < 250\ MHz$$

$$Delay \le 544 + \frac{36}{\sqrt{f}}; \quad Skew \le 30$$

C. Outlets

1. Outlet Locations

a. Unless otherwise noted on the floor plans or within this document, all voice and data wall outlets for 24 AWG copper cable shall be:

(1) 4-position/ 8-conductor modular outlets
(2) Insulation displacement
(3) Support Universal applications in a multivendor environment, accepting modular RJ-11 jacks (telephone) and RJ-45 Jacks (data).
(4) Provided with blank module inserts for all unused module locations. Jack module arrangements are shown on the drawings. Provide color coded inserts at each outlet, termination block and at patch panels as shown on the drawings.
(5) Mounted in one or two gang utility outlet boxes.
(6) Equipped with EIA/TIA-T568A and EIA/TIA-T568B universal wiring labels.

2. Category 5E Power Sum Outlets

a. All Category 5E outlets shall meet or exceed Power Sum NEXT and Category 5E transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section, and be part of the UL® LAN Certification and Follow-up Program.
b. The Category 5E outlets shall be capable of being in a modular patching situation or as a modular telecommunication outlet (TO) supporting current and evolving high-speed, high-bandwidth applications, including Ethernet, 1000BASE-T, Token Ring, 100 Mbps TP-PMD, 155 Mbps ATM, 622 Mbps ATM using parallel transmission schemes.
c. The outlet shall use either the EIA/TIA-T568A or EIA/TIA-T568B wiring.
d. The Category 5E outlets shall be capable of being installed at a 90° angle in any series of modular faceplate, frame, or surface-mounted box avoiding the need for special faceplates.
e. Snap-on icons shall identify the outlet as a Category5E to distinguish it from other Category Series outlets.
f. General specifications:

(1) Meets or exceeds the mechanical, electrical, and clearance specifications in FCC Rules and Regulations, Part 68, Subpart F
(2) Meet or exceed the Category 5E requirements in ISO/IEC 11801, CENELEC EN 50173, and ANSI/EIA/TIA 568B
(3) Certifications: UL Listed, CSA Certified and AUSTEL approved.

g. Electrical Performance:

Dielectric Withstand Voltage	1000 VAC RMS, 60 Hz minimum, contact-to-contact
Insulation Resistance	500 M ohms minimum
Contact Resistance	20 M ohms maximum
Current Rating	1.5A at 68°F (20° C) per IEC Publication 512-3, Test 5b
Transmission	NEXT, FEXT, ELFEXT, and Attenuation

Performance	measurements were made per ANSI/EIA/TIA 568-B

h. Mechanical Performance:

Plug/Jack Contact Force	100 grams minimum per contact using FCC approved plug
Plug Retention Force	30 lb. (133 N) minimum
Temperature Range	-40° to 150° F (-40° C to 66° C)
Plug Insertion Life:	750 insertions
IDC Terminations:	200 terminations

i. Physical Characteristics:

Dimensions	0.8″ (20 mm) W x 0.8″ (20 mm) H x 1.2″ (31 mm) D
Plastic	High-Impact, flame-retardant. UL-rated 94V-0 thermoplastic
Outlet Wires	Copper alloy, 1.27 µm lubricated gold plating over 2.54 µm nickel underplate
Connector	Insulation displacement connectors (IDC) accept 22 & 24 AWG wire

3. Category 6 Gigabit outlets

a. All Category 6 outlets shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard and be part of the UL® LAN Certification and Follow-up Program.

b. The Category 6 outlets shall be backward compatible with Category 5E, 5 and 3 cords and cables.

c. The Category 6 outlets shall be capable of being in a modular patching situation or as a modular telecommunication outlet (TO) supporting current 10Base-T, Token Ring, 100 Mbps TP-PMD, 155 Mbps ATM, 622 Mbps ATM using parallel transmission schemes and evolving high-speed, high-bandwidth applications, including Ethernet, 1000BASE-T and 1.2 Gbps ATM.

d. The Category 6 outlets shall be capable of being installed at a 90° angle in any series modular faceplate, frame, or surface-mounted box avoiding the need for special faceplates.

e. The Category 6 outlets shall have improved pair splitters and wider channel for enhanced conductor placement. The outlet shall also have a low-profile wire cap, which protects against contamination and secures the connection. Multicolored identification labels shall be available to assure accurate installation.

f. The Category 6 outlets shall meet the following Guaranteed Margin Performance and Physical Specifications:

(1) Guaranteed Margin:

	Category 6 Outlet	High Performance Channel	Premium Performance Channel
	Typical Worst Pair Margin*	Guaranteed Margin**	Guaranteed Margin**
Insertion Loss	26.9%	5.0%	7.5%
NEXT	5.4 dB	6.0 dB	7.0 dB
PSNEXT	4.7 dB	7.5 dB	8.5 dB

ELFEXT	10.5 dB	6.0 dB	8.0 dB
PSELFEXT	10.8 dB	8.0 dB	10.0 dB
Return Loss	8.0 dB	4.0 dB	4.0 dB
Frequency Range	1-250 MHz	1-250 MHz	1-250 MHz

* Typical worst pair swept margin when measured with same manufacture's Cat 6 modular patch cord.
**Guaranteed margin is valid at any frequency from 1-250 MHz for the single manufacturer's certified channel comprising the single manufacturer's Cat 6 apparatus and the single manufacturer's High Performance series cable or Premium Performance series. Values represent margin over the draft Category 6/Class E channel specifications.

(2) Physical Specifications:

Dimensions	0.8 in (20 mm) W x 0.8 in (20 mm) H x 1.2 in (31 mm) D
Plastic	High-impact, flame-retardant, UL rated 94V-0 thermoplastic
Connector	Copper alloy, 100 micro-inch bright solder over 100 micro-inch nickel underplate
Outlet Wires	Copper alloy, 50 micro-inch lubricated gold plating over 100 micro-inch nickel underplate
Operating Temperature	14°F to 140°F (-10°C to 60°)
Storage Temperature Range	-40°F to 158°F (-40°C to 70°C)
Humidity	95% (noncondensing)
Nominal Solid Conductor Diameter:	0.025 to 0.020 in (22 to 24 AWG)
Nominal Stranded Conductor Diameter	0.64 to 0.51mm (22 to 24 AWG)
Plug Retention Force	30lb (133 N) minimum
Plug / Jack Contact Force	100 grams minimum per contact using FCC-8 position telecommunication plug
Insertion Life	750 cycles minimum using FCC-8 position telecommunication plug

2.3 MOUNTING ELEMENTS

A. Raceways and Boxes: Comply with Section 16130.

2.4 TWISTED-PAIR CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

A. Listed as complying with Category 5E, and 6 of EIA/TIA-568-B.

B. Conductors: Solid copper

C. Station cable

1. Category 5E UTP, 4 Pair

a. Category 5E UTP cables shall extend between the station location and its associated TR and consists of 4 pair, 24 gauge, UTP, and shall terminate on 8 pin modular jacks provided at each outlet.

b. Cable jacket shall comply with Article 800 NEC for use as a plenum or non-plenum cable. The 4 pair UTP cable shall be UL® and c (UL®) Listed Type CMP (plenum) or CM (non-plenum).

c. All 4 pair Category 5E cables shall conform to ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section, and be part of the UL® LAN Certification and Follow-up Program.

d. Applications standards supported should include, but not limited to, IEEE 802.3, 1Base5, 10BASE-T; IEEE 802.5, 4 Mbps, 16Mbps (328 ft [100m], 104 Workstations) and TP-PMD. In addition, cables shall be capable of supporting current and evolving high-speed, high-bandwidth applications, including Ethernet, 1000BASE-T, Token Ring, 100 Mbps TP-PMD, 155 Mbps ATM, 622 Mbps ATM using parallel transmission schemes.

e. All Category 5E cables shall meet or exceed the electrical and physical specifications; and the guaranteed performance characteristics as follows:

(1) Electrical Specification:

Nominal Velocity of Prop (NVP)	Non-plenum 0.70, Plenum 0.75
Maximum DC Resistance	28.6 OHM/1000ft (9.38 OHM/100m)
Max DC Resistance Unbalance	5%
Mutual Capacitance at 1 kHz	14 nF/1000 ft (4.59 nF/100 m)
Max Capacitance Unbalanced p to g	400 pF/1000 ft (131.2 pF/100 m)
Characteristic Impedance	At 0.772 MHz: 105 +/- 15 OHM
	At 1.0-100 MHz: 100 +/- 15 OHM
Attenuation dB/328 ft [100 m]	At 1 MHz 1.9
	At 4 MHz 3.8
	At 10 MHz 6.1
	At 16 MHz 7.7
	At 20 MHz 8.7
	At 62.5 MHz 15.8
	At 100 MHz 20.4
Standards	ANSI/TIA/EIA-568-B.1 and ANSI/TIA/EIA-568-B.2 Category 5E
	ISO/IEC 11801: 2002 (2nd Edition) Class D
	CENELEC EN-50173: 2002 2nd Edition Category 5E

(2) Physical Specification:

Gauge	24 AWG
Insulation Thickness	Non-plenum - 0.008 in (0.20 mm) Plenum – 0.005 in (0.13 mm)
Jacket Thickness	Non-plenum - 0.026 in (0.66 mm) Plenum - 0.015 (0.38 mm)
Outside Diameter	Non-plenum - 0.220 in (5.60 mm) Plenum - 0.015 in (0.38 mm)

(3) Category 5E cables guaranteed performance to 350 MHz over Swept Frequency:

Freq. MHz	Atten. dB/100m	CAT 5E Standard	Power Sum Near End Crosstalk dB	CAT 5E Standard	Pair to Pair Near End Crosstalk dB	CAT 5E Standard	Attenuation to Crosstalk Ratio dB/100m	CAT 5E Standard
0.772	1.7	< 1.8	67.0	64.0	70.0	67.0	68.3	n/a
1	2.0	< 2.0	65.3	62.3	68.3	65.3	66.3	n/a
4	3.9	< 4.1	56.3	53.3	59.3	56.3	55.4	n/a
8	5.6	< 5.8	51.8	48.8	54.8	51.8	49.2	n/a

10	6.3	< 6.5	50.3	47.3	53.3	50.3	47.0	n/a
16	8.0	< 8.2	47.3	44.3	50.3	47.3	42.3	n/a
20	9.0	< 9.3	45.8	42.8	48.8	45.8	39.8	n/a
25	10.1	< 10.4	44.3	41.3	47.3	44.3	37.2	n/a
31.25	11.4	< 11.7	42.9	39.9	45.9	42.9	34.5	n/a
62.5	16.5	< 17.0	38.4	35.4	41.4	38.4	24.9	n/a
100	21.3	< 22.0	35.3	32.3	38.3	35.3	17.0	n/a
155	27.2	n/a	32.5	n/a	35.5	n/a	8.2	n/a
200	31.4	n/a	30.8	n/a	33.8	n/a	2.4	n/a
220	33.2	n/a	30.2	n/a	33.2	n/a	0.0	n/a
300	39.7	n/a	28.2	n/a	31.2	n/a	n/a	n/a
350	43.5	n/a	27.2	n/a	30.2	n/a	n/a	n/a
0.772	70.0	66.0	68.0	63.0	n/a	n/a	25.0	< 45
1	67.8	63.8	65.8	60.8	20.0	20.0	25.0	< 45
4	55.7	51.7	53.7	48.7	23.0	23.0	25.0	< 45
8	49.7	45.7	47.7	42.7	24.5	24.5	25.0	< 45
10	47.8	43.8	45.8	40.8	25.0	25.0	25.0	< 45
16	43.7	39.7	41.7	36.7	25.0	25.0	25.0	< 45
20	41.7	37.7	39.7	34.7	25.0	25.0	25.0	< 45
25	39.8	35.8	37.8	32.8	24.3	24.3	25.0	< 45
31.25	37.9	33.9	35.9	30.9	23.6	23.6	25.0	< 45
62.5	31.8	27.8	29.8	24.8	23.0	21.5	25.0	< 45
100	27.8	23.8	25.8	20.8	23.0	20.1	25.0	< 45
155	23.9	n/a	21.9	n/a	18.8	n/a	25.0	n/a
200	21.7	n/a	19.7	n/a	18.0	n/a	25.0	n/a
220	20.9	n/a	18.9	n/a	17.7	n/a	25.0	n/a
300	18.2	n/a	16.2	n/a	16.8	n/a	25.0	n/a
350	16.9	n/a	14.9	n/a	16.3	n/a	25.0	n/a

2. Category 6 FTP, 4 Pair (High Performance Shielded Cable)

   a. The high performance Category 6 UTP cable shall be of the traditional round design with mylar separator tape between pairs 2 & 3 and 1 & 4 and integral foil shield.

   b. The cable shall support Voice, Analog Baseband Video/Audio, Fax, Modem, T-1, ISDN,RS-232, RS422, RS-485, 10BASE – T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 MHz) of analog broadband video.

   c. The cable jacket shall comply with Article 800 NEC for use as a riser, plenum or non-plenum cable. The 4 pair UTP cable shall be UL® Listed Type CMP (plenum) or CM (non-plenum).

   d. Performance shall be characterized to 550 MHz to support high-bandwidth video applications

e. All Category 6 high performance cables shall the following specification:

	Non Plenum	Plenum
Weight	25.3 lb (1000 ft)	29 lb (1000 ft)
Outside Diameter	0.232 in	0.22 in
Conductor Diameter	.022 in	.022 in
Jacket Material	PVC	Low Smoke PVC
Maximum Pulling Tension	25 lbs	25 lbs
Nom. Velocity of Propagation	0.69	0.72
Max DC Resistance	9.83 Ohms/100m	9.83 Ohms/100m
Mutual Capacitance @ 1kHz	4.95 nF/100m	4.78 nF/100m
Operating Temperature	-20 to 60° C	-20 to 60° C
UL Type	CMR & CMG	CMP

f. The high performance Category 6 cable shall be specified to 550 MHz and shall meet the guaranteed swept margin as follows:

	High Performance Cable	High Performance Channel	Premium Performance Channel
	Typical Worst Pair Margin*	Guaranteed Margin**	Guaranteed Margin**
Insertion Loss	3.0 %	5.0%	7.5%
NEXT	6.0 dB	6.0 dB	7.0 dB
PSNEXT	6.0 dB	7.5 dB	8.5 dB
ELFEXT	5.0 dB	6.0 dB	8.0 dB
PSELFEXT	5.0 dB	8.0 dB	10.0 dB
Return Loss	4.0 dB	4.0 dB	4.0 dB
Frequency Range	1-550 MHz	1-250 MHz	1-250 MHz

* Typical worst pair swept margin.
**Guaranteed margin is valid at any frequency from 1-250 MHz for the single manufacturer's certified channel comprising the single manufacturer's Cat 6 apparatus and the single manufacturer's High Performance series cable or Premium Performance series. Values represent margin over the draft Category 6/Class E channel specifications.

D. Copper cable – Telephone Building Riser

1. Shielded 24 AWG multi-pair copper cables shall be used as the vertical riser cables. The cable shall support voice data applications.
2. Shielded
3. The shielded riser rated, plenum and nonplenum cable shall consist of solid-copper conductors insulated with expanded polyethylene covered by a PVC skin, be conformance tested to meet EIA/TIA 568-B for Category 5 cables, be UL® and c (UL®) Listed as CMR.
4. The PVC sheath shall have improved frictional properties, allowing it to be pulled through conduit without the use of lubricants.
5. The cable shall be available in 25, 50, 100, 150, 200, 300, 400, 600, 900, 1200, 1500, and 1800 pair counts.
6. UL® and c (UL®) Listed for Fire Safety
7. ISO 9001 Certified Manufacturer
8. The copper riser cable shall meet or exceed the following electrical specifications listed below:

Electrical Specifications:

Average DC Resistance	26.5Ω/1,000 ft (8.7Ω/100m), maximum
Average DC Resistance Unbalance	1.7%, maximum
Mutual Capacitance @ 1kHz	16 nF/1000 ft (5.25 nF/100 m), maximum
Capacitance Unbalance (pair to ground)	201pF/1,000 ft (65.94 pF/100m) maximum

Attenuation (dB/100 m [328 ft.] :

Frequency	Attenuation (Max.)
1.00 MHz	2.3 dB
4.00 MHz	4.9 dB
10.00 MHz	8.5 dB
16.00 MHz	12 dB

Worst Pair Near-End Crosstalk (NEXT) dB/100 m [328 ft]:

Frequency	Pair-To-Pair NEXT (Max.)
1.0 MHz	13.8 dB
4.0 MHz	11.2 dB
10.0 MHz	10.2 dB
16.0 MHz	9.2 dB

2.5 IDENTIFICATION PRODUCTS

A. Comply with Division 16 Section 16050, "Basic Electrical Materials and Methods," "Electrical Identification" and the following:

1. Cable Labels: Self adhesive vinyl or vinyl cloth wraparound tape markers, machine printed with alphanumeric cable designations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cable. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CABLING SYSTEM BASIC REQUIREMENTS

A. Cable Pathway

1. Installation of all fiber, data, and voice cables shall be within raceway, conduit, cable tray jhooks, bridal rings or other designated cable delivery system provided and installed by the (electrical contractor) as shown on the electrical drawings.

a. All cables installed concealed in walls shall be installed in conduit only.

b. All cables installed surface mounted on walls shall be installed in surface mounted raceway, as shown on the electrical or communication drawings.

c. All exposed cabling above ceilings in plenum and non-plenum spaces may be run in conduit, cable tray, or other designated cable delivery system(s) as indicated on the electrical or communication drawings.

B. Hardware

1. Provide all required hardware including, but is not limited to, termination panels and blocks, fastening devices, data outlets, voice outlets, connectors and all required accessories to comply with this specification.

3.3 INSTALLATION

A. Install cable using techniques, practices, and methods that are consistent with category rating of components and that ensure category performance of completed and linked signal paths, end to end.

B. Install cable without damaging conductors, shield, or jacket.

C. Do not bend cable in handling or in installing to smaller radii than minimums recommended by manufacturer.

D. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously if more than one is being installed in the same raceway.
2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
3. Use pulling means; including fish tape, cable, rope, and basket weave wire/cable grips, which will not damage media or raceway.

E. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

F. Secure and support cable at intervals not exceeding 30" and not more than 6" from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

G. Wiring on Wiring Racks and Enclosures: Provide adequate length of conductors. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

H. Separation of Wires: Comply with EIA/TIA-569 rules for separating unshielded copper communication and data processing equipment cables from potential EMI sources, including electrical power lines and equipment.

I. Make terminations only at indicated outlets, terminals, and cross connect and patch panels.

J. The entire in installation shall be completed in conformance with ANSI/EIA/TIA 568-B standards, NECA/BICSI 586-2006 Installing Commercial Building Telecommunications Cabling standard, all federal and local standards and the manufacturer's design and installation guidelines.

1. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines will require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This

shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

K. Power Separation

1. The Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.

L. Miscellaneous Equipment

1. The Contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, wire molding (MC, ER, & TR locations), miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the System.

M. Special Equipment and Tools

1. It shall be the responsibility of the Contractor to furnish any special installation equipment or tools necessary to properly complete the System.

a. Tools shall include, but are not limited to:

(1) Tools for terminating cables
(2) Testing and splicing equipment for copper/fiber cables
(3) Communication devices
(4) Jack stands for cable reels
(5) Cable winches

N. Cable Storage

1. The Contractor shall not roll or store cable reels without an appropriate underlayment and the prior approval of Engineer/Owner, or it's General Contractor.

O. Cable Records

1. The Contractor shall maintain conductor polarity (tip and ring) identification at the main equipment room (switch room), risers, and station connecting blocks in accordance with industry practices.

3.4 GROUNDING AND BONDING

1. All grounding and bonding shall meet the National Electrical Code (NEC®) as well as local codes, which specify additional grounding and/or bonding requirements.
2. Bonding and Grounding

a. Communication bonding and grounding shall be in accordance with the NEC and NFPA. Horizontal cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes cross connect frames, patch panels and racks, active telecommunication equipment and test apparatus and equipment.

B. Comply with Division 16 Section 16060, "Grounding and Bonding."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.

D. Bond shield and drain conductors to ground at only one point in each circuit.

E. Bonding and Grounding Terminal: Locate in each equipment room and wiring closet.

1. Telecommunications Bonding Backbone

a. Provide a Telecommunications Bonding Backbone utilizing a #6-AWG or larger bonding conductor that provides direct bonding to the building's electrical system and all conductive metallic parts of the communications system in accordance with Article 250 of the NEC. Supplementary grounding systems will not be allowed. This is part of the grounding and bonding infrastructure (part of the telecommunications pathways and spaces in the building structure), and is independent of equipment or cable.

3.5 WORKMANSHIP

A. Components of the CCS system shall be installed in a neat, workmanlike manner.

B. Wiring color codes shall be strictly observed and terminations shall be uniform throughout the system.

C. Identification markings and systems shall be uniform.

D. ANSI/TIA/EIA 568-B wiring codes shall standardize all CCS wiring.

3.6 WORK AREA

A. Work location information outlets

1. All outlets, including conduit stub-ups shall be provided by the electrical contractor as shown on the Electrical Drawings or as directed by the Engineer/Owner.

3.7 HORIZONTAL CABLING

A. Contractor shall supply horizontal cables to connect each information outlet to the backbone system as shown on the contract drawings.

B. Unless otherwise noted on the floor plans or within this document, the type of horizontal cables used for each work location shall be [4-pair unshielded twisted pair (UTP)] or [4-pair shielded twisted pair (FTP)], as specified in this section.

C. The 4-pair shall be run using a star topology format from the administration subsystem (Telecommunications Room) on each floor to every individual Telecommunication Outlet.

D. All cable routes to be approved by Engineer/Owner prior to installation of the cabling.

E. The length of each individual run of horizontal cable from the administration subsystem (Telecommunications Closet) on each floor to the Telecommunication Outlet shall not exceed 295 ft (90 m).

F. Contractor shall observe the bending radius and pulling strength requirements of the 4-pair cable during handling and installation.

G. Each run of cable between the termination block and the information outlet shall be continuous without any joints or splices.

H. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall bundle station wiring with Velcro cable ties at a distance not to exceed 5'-0" on center.

I. The cable bundling shall be supported via "J" hooks and bridal rings attached to the existing building structure and framework. Refer to Division 26 Section 26 7130, "Telephone and Cable Pathways."

J. Plenum cable will be used in all appropriate areas.

K. Every effort will be made to schedule the requirements under this Contract in such a manner so as to complete all above ceiling work prior to ceiling tile installation. In the event Contractor is required to remove ceiling tiles, such Work shall not break or disturb grid and must be coordinated with the General Contractor.

L. Contractor shall provide Engineer/Owner with detailed cable run diagrams for cable runs within raised floors detailing exact locations of cable for review and approval by Engineer/Owner after coordination with other contractors, architect and general contractor.

M. Conduit installation shall be as required in Division 26 Section 26 0533, "Raceways and Boxes" of these specifications.

N. Station cables and tie cables installed within ceiling spaces shall be routed through these spaces at right angles to electrical power circuits.

3.8 IDENTIFICATION

A. Identify system components complying with applicable requirements in Division 16 Section 16050, "Basic Electrical Materials and Methods," "Electrical Identification" and the following Specifications.

B. System: Use a unique, four syllable alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.

1. First syllable identifies whether it is a data or telephone outlet.
2. The second letters or numbers indicate MDF or IDF termination point.
3. The remaining numbers indicate cable designation.

C. Workstation: Label cables within outlet boxes.

D. Cables, General: Label each cable within 4 inches of each termination, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

E. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.

F. Cable Schedule: Post in prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Provide electronic copy of final comprehensive schedules for Project, in software and format selected by Owner.

G. All labels shall be machine printed. Labels shall not be written by hand.

3.9 SPECIAL REQUIREMENTS FOR CABLE ROUTING

A. Cabling

1. All communications cabling used throughout this project shall comply with the requirements as outlined in the National Electric Code (NEC) Articles 725, 760, 770, and 800 and the appropriate local codes.

2. All copper cabling shall bear CMP (Plenum Rated), CM/CMR (Riser Rated) and/or appropriate markings for the environment in which they are installed.
3. All fiber optic cabling shall bear OFNP (Plenum Rated), OFNR (Riser Rated) and/or appropriate markings for the environment in which they are installed.

B. Cable Pathway

1. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall install cable bundles of 50 or less, station wiring with VELCRO cable ties snug, but not deforming the cable geometry.
2. Cable bundles shall be supported via "J" hooks or bridal rings attached to the existing building structure and framework at a maximum of five (5) foot intervals.
3. Plenum rated cable ties shall be used in all appropriate areas.
4. The contractor shall adhere to the manufacturers' requirements for bending radius and pulling tension of all data and voice cables.
5. Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid.
6. Cables shall not be attached to or supported by fire sprinkler heads or delivery systems or any environmental sensor located in the ceiling air space (NO EXCEPTIONS).
7. Cables shall not be supported from the suspended ceiling grid hangers (NO EXCEPTIONS).

C. Fire Stopping

1. Sealing of openings between floors, through rated fire and smoke walls, existing or created by the contractor for cable pass through shall be the responsibility of this contractor.
2. Sealing material and application of this material shall be accomplished in such a manner, which is acceptable to the local fire and building authorities having jurisdiction over this work. Refer to Division 26 Section 26 0505, "Basic Materials and Methods" for Fire stopping specifications.
3. Creation of such openings as are necessary for cable passage between locations as shown on the drawings shall be the responsibility of this contractor's work.
4. Any openings created by or for the contractor and left unused shall also be sealed as part of this work.

D. Contractor Responsibility

1. The contractor shall be responsible for damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including painting, shall be included as necessary.

3.10 DAMAGES

A. The Contractor shall be liable for any and all damages to portions of the building caused by it, its employees or subcontractors; including but not limited to:

1. Damage to any portion of the building caused by the movement of tools, materials or equipment.
2. Damage to any component of the construction of spaces "turned over" to the Contractor.

3. Damage to the electrical distribution system and/or other space "turned over" to the Contractor.
4. Damage to the electrical, mechanical and/or life safety or other systems caused by inappropriate operation or connections made by the Contractor or other actions of Contractor.
5. Other damage to the materials, tools and/or equipment of the owner, its consultants, General Contractor, subcontractors, Architect, Engineer, other contractors, agents and lessees.

3.11 PENETRATIONS OF WALLS, FLOORS, AND CEILINGS

A. Prior consent

1. The Contractor shall make no penetration of floors, walls or ceiling without the prior consent of the Architect/Engineer/Owner and General Contractor.

B. Sealing penetrations

1. Where penetrations through acoustical walls or other walls for cableways have been provided for the Contractor or made by the Contractor, such penetrations shall be sealed by the Contractor in compliance with applicable code requirements and as directed by Engineer, Owner, Architect, or General Contractor.
2. Where penetrations through fire-rated walls for cableways have been provided for the Contractor or made by the Contractor, such penetrations shall be sealed by the Contractor as required by code and as directed by Engineer, Owner, Architect, or General Contractor.
3. Contractor shall, prior to the commencement of on-site activities, submit to Engineer/Owner for review by its Architect, details of any special systems to be used.

3.12 ON SITE MOVE-IN DAY SUPPORT

A. Technical Support

1. Contractor will provide technical support on a per/hour basis at such levels and at such times as Owner deems necessary during the physical move to the site.
2. The personnel providing technical support will:
   a. Have intimate knowledge of the System and Materials that were used
   b. Be skilled in all use of equipment and materials used under the Contract
   c. Be competent to troubleshoot and fix problems associated with Contractor provided materials

3.13 PROJECT DIRECTION

A. Single Point of Contact

1. Contractor will provide a single point of contact, i.e., Project Manager, to speak for the Contractor and to provide the following functions:
   a. Initiate and coordinate tasks with Owner, its General Contractor, Architect, Engineer, and others as specified by the Owner
   b. Provide day-to-day direction and on-site supervision of Contractor personnel

B. Ensure conformance with all Contract provisions

3.14 FIELD QUALITY CONTROL

A. Copper Cable testing

1. Testing of all copper wiring shall be performed prior to system cutover.
2. 100 percent of the horizontal and riser wiring pairs shall be tested for opens, shorts, polarity reversals, transposition and presence of AC voltage.
3. Voice and data horizontal wiring pairs shall be tested from the information outlet to the ER or TR.
4. The Category 5E cable runs shall be tested for conformance to the specifications of EIA/TIA 568-B Category 5E.
5. The Category 6 cable runs shall be tested for conformance to the specifications of EIA/TIA 568-B Category 6.
6. Category 5E and Category 6 horizontal cables shall be tested according to test set manufacturer's instructions utilizing the latest firmware and software.
   a. Testing shall include all of the electrical parameters as specified in the Products Section of this document.
   b. Any pairs not meeting the requirements of the standard shall be brought into compliance by the contractor, at no charge to the Owner.
7. Complete, end to end, test results must be submitted to Engineer/Owner.

3.15 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.16 COMPLETION OF WORK

A. At the completion of the System, the Contractor shall restore to its former condition, all aspects of the project site and on a daily basis, shall remove all waste and excess materials, rubbish debris, tools and equipment resulting from or used in the services provided under this Contract.

B. All clean up, restoration, and removal noted above shall be by the Contractor and at no cost to the Owner.

C. If the Contractor fails in its duties under this paragraph, the Owner may upon notice to the Contractor perform the necessary clean up and deduct the costs thereof from any amounts due or to become due to the Contractor.

D. It shall be the Contractor's responsibility to remove trash from the areas it is working in and bring trash and debris to the dumpster.

E. The Contractor shall not use the General Contractor's dumpsters or trash disposal without prior approval of the General Contractor.

END OF SECTION

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